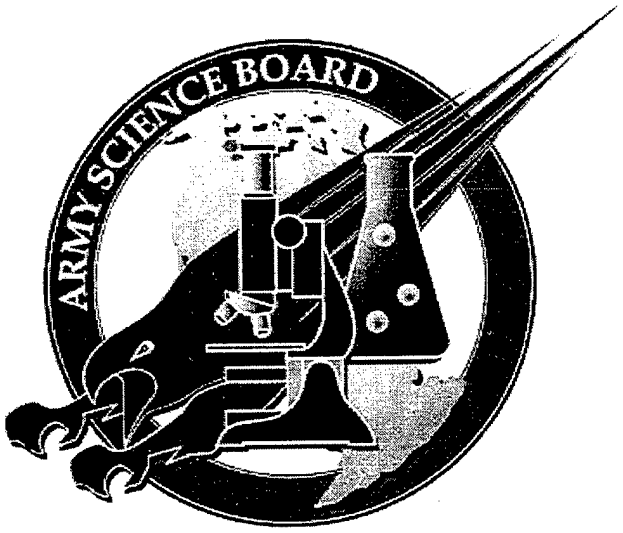
ARMY SCIENCE BOARD

1997 SUMMER STUDY

FINAL REPORT



DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY OF THE ARMY
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WASHINGTON, D.C. 20310-0103

"DISTANCE LEARNING"

December 1997

DISCLAIMER

This report is the product of the Army Science Board (ASB). The ASB is an independent, objective advisory group to the Secretary of the Army (SA) and the Chief of Staff, Army (CSA). Statements, opinions, recommendations and/or conclusions contained in this report are those of the 1997 Summer Study Panel on Distance Learning and do not necessarily reflect the official position of the United States Army or the Department of Defense (DoD).

CONFLICT OF INTEREST

Conflicts of interest did not become apparent as a result of the Panel's recommendations.

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A study reviewing the existing Army Distance Learning Plan (ADLP) and current Distance Learning practices, with a focus on the Army's training and educational challenges and the benefits of applying Distance Learning techniques. The ASB study panel makes six specific recommendations, the most important of which is Accelerating CourseWare (CW) development. The panel also recommends placing heavier reliance on DL-Collaborative which should pay huge dividends. A crucial improvement to the total program is establishing an Army DL Futures Lab. The study concluded accelerated DL CW applications will provide quicker ROI through reduced TDY and per-diem costs and reductions in overall DL implementation costs.

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AUTHORS' NOTE

We pleased to present this final report of the Army Science Board (ASB) Study on Distance Learning (DL). An ASB study panel consisting of 16 members convened from October 1996 through the completing of this report to review the topics of the Army's Distance Learning Plan (ADLP), and innovative, leading edge developments in Industry and Academe Distance Learning initiatives. The Distance Learning panel focused on reviewing the Army's' Distance Learning Plan; recommended improvements to the plan; and characterizing training, development and delivery beyond the plan.

We extend our sincere appreciation to all the Study Panel members: Dr. Sue Berryman, Dr. Sung Lee, Dr. Philip Dickinson, Ms. Susan Lowenstam, Dr. Edward Gerry, Dr. Warren Morrison, Dr. Richard Hartman, Dr. Harry O'Neil, Dr. Walter Laberge, Dr. Peter Lee, Dr. Karen Pettigrew, Dr. Wilson Talley, Dr. Harry Tredennick and LTG (USA, Ret.) Ronald Watts, for all their time, effort and personal sacrifice during the course of the study. The briefing of the study result was well received by the sponsors, LTGs Miller and Holder, who expressed their gratitude for the Panel's effort.

We would also extend a thank you to COL Francis Coppola of the USA Combined Arms Center, our staff assistant and Reserve Component integrator on the study subject. His support and dedication to educating the Distance Learning Panel in the critical issues surrounding the study topic impact on the Reserve were invaluable.

Dr. Joseph V. Braddock
Study Chair

LTG (USA, Ret.) W. Dutch Shoffner
Study Co-Chair

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  - CMU Intelligent Tutoring Project; CMU Just-in-time Learning; CMU OnLine; CMU SEI Managing Software Development (MSD) Course
  - University of Alabama, Huntsville (UAH)
  - Georgia State University
  - Kansas University
  - Lockheed Martin Missiles & Space
  - NASA Ames Research Center
  - One Touch Systems
  - RAND Corporation
  - Sun Micro Systems
  - California Virtual University
  - UMASS Department of Computer Science
  - UNL Department of Distance Education
  - Ohio State University
  - MITRE Corporation
  - Ft Knox Armor Center & School
  - Combined Arms Center & Ft Leavenworth
  - State of Georgia
  - Institute of Electrical & Electronic Engineers
  - Union City
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Executive Summary

Business, industry and academia are ahead of the Army in use of DL in its various modes. Most importantly, they are increasingly focusing on a particularly effective DL mode which the ASB panel terms "DL-Collaborative". This mode permits maximum flexibility with students working over electronic media (most likely the Internet), seeking out subject matter experts and working with each other. This mode also allows instruction or learning to occur at a time and place convenient to the student and has been shown to enable both faster and better learning.

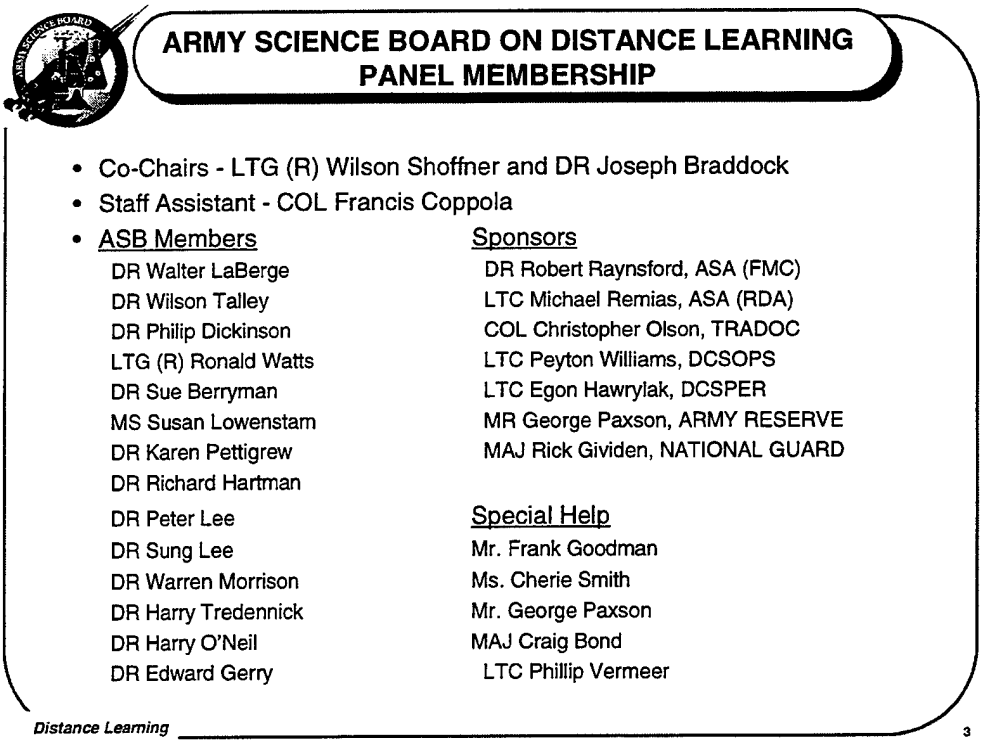
The Army has already established **the** world class training methodology in its CTCs, which employ a synchronous format. The Army should exploit this strength by utilizing the Army's CTC framework to establish courses delivered via the asynchronous DL-Collaborative method.

An immediate implication for the Army is that adoption of this mode would have a pronounced, beneficial effect on the TTHS account with realization of cost transfer in dollars and savings in available man-years. Training could be provided locally at a time convenient to the Soldier as well as his commander with TDY and per diem costs greatly reduced.

Unlike our sister services, the Army has developed a Distance Learning plan. The plan, however, is too focused on an older learning mode. Known as "synchronous remote distance learning", this mode intellectually perpetuates the traditional teaching paradigm of an instructor presenting material to an assemblage of students at a prescribed time. This DL mode also carries heavy infrastructure costs, funding the ASB panel advises be redirected to accelerating courseware development.

For these reasons the panel recommends updating the current Army Distance Learning Plan to include extensive use of the DL-Collaborative mode and accelerating the implementation of Distance Learning to expedite realization of cost transfer and manpower savings and reduce the overall costs of implementing DL.

The study also makes comments and recommendations regarding management issues, inclusion of the civilian workforce, and teaming with universities and industry.



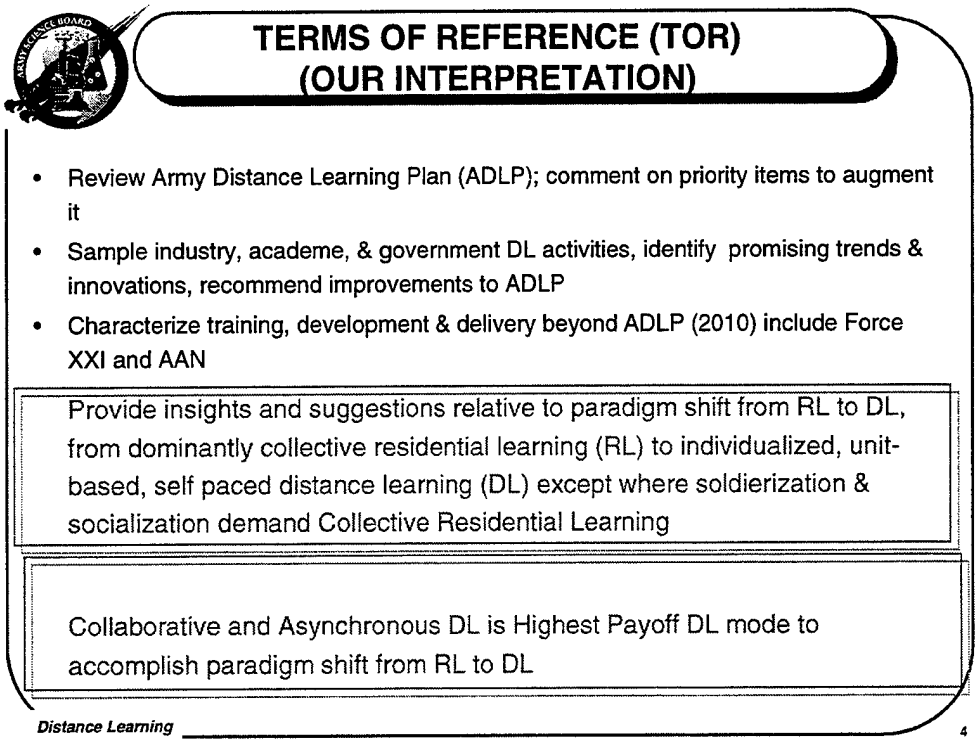
The Army Science Board on Distance Learning

Study Panel

This Panel emanated from an inquiry by the Assistant Secretary of the Army, Financial Management and Comptroller (ASA FMC) to the Army Science Board to include a study of the Army's Distance Learning Plan as one of the 1997 Summer Study topics. The selection of the Army Science Board panel for the Distance Learning (DL) study was completed in the fall of 1996 (Appendix B provides a complete participant list). The Co-Chairs of this Study Panel effort were LTG (Ret) Wilson Shoffner and DR Joseph Braddock. The purpose of the study was to understand the Army's training and educational challenge and to determine potential distance learning payoffs.

It was imperative for all involved to begin with a common reference point concerning distance learning basics. Important insights were gained through the sampling conducted by the panel. These insights provided a clear understanding of the framework present in the DL environment of industry, academe, and government, and as a result, allowed the Panel to review and compare the Army's DL program elements and initiatives.

Through this phased process, the Panel deliberated their findings and conclusions concerning the current and potential future state of DL. This process was based on analysis of a suggested vision, developing an intellectual framework, and specific recommendations to proceed.



Terms of Reference (TOR)

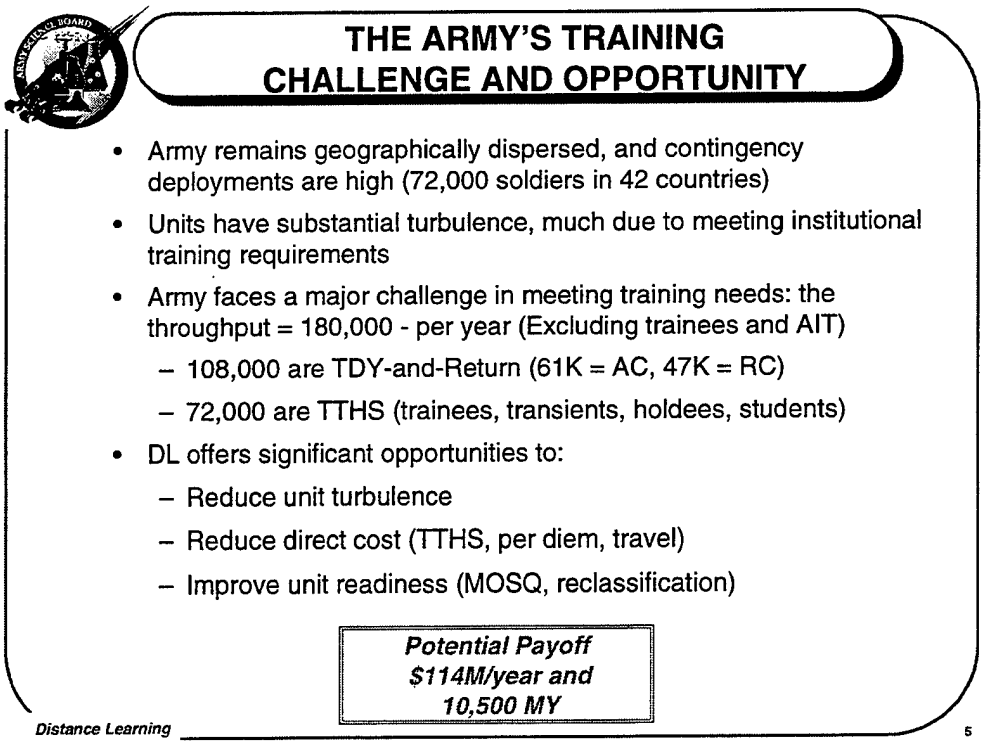
The finalized Terms of Reference – to review the Army Distance Learning Plan (ADLP); Sample Industry, Academe & Government DL initiatives; and to characterize training, development and delivery beyond the ADLP were developed through communication, cooperation and staffing with the sponsors and other interested organizations mentioned below:

Organization	*Sponsor*	*Point of Contact(s)*
ASA (FMC)	DR Raynsford	MS Rebar
ASA (RDA)	DR Decker	LTC Remias
HQS TRADOC	LTG Miller	MR Seger, COL Olson
HQS CAC	LTG Holder	COL Coppola
HQS DA DCSOPS	BG Dubik	COL Gunlicks , LTC Williams
OCAR		MR Paxson
NGB		MAJ Bond, MAJ Gividen

(Refer to Appendix A for a complete copy of the final TOR.)

The Panel's endeavors were to provide insights and suggestions relative to the paradigm shift from Residential Learning (RL) to DL , from predominantly collective RL to individualized, unit-based, self paced DL, except where soldierization and socialization demand the collective residential environment.

The Panel's assessment is that Collaborative and Asynchronous DL is the highest payoff DL mode to accomplish this paradigm shift from RL to DL.



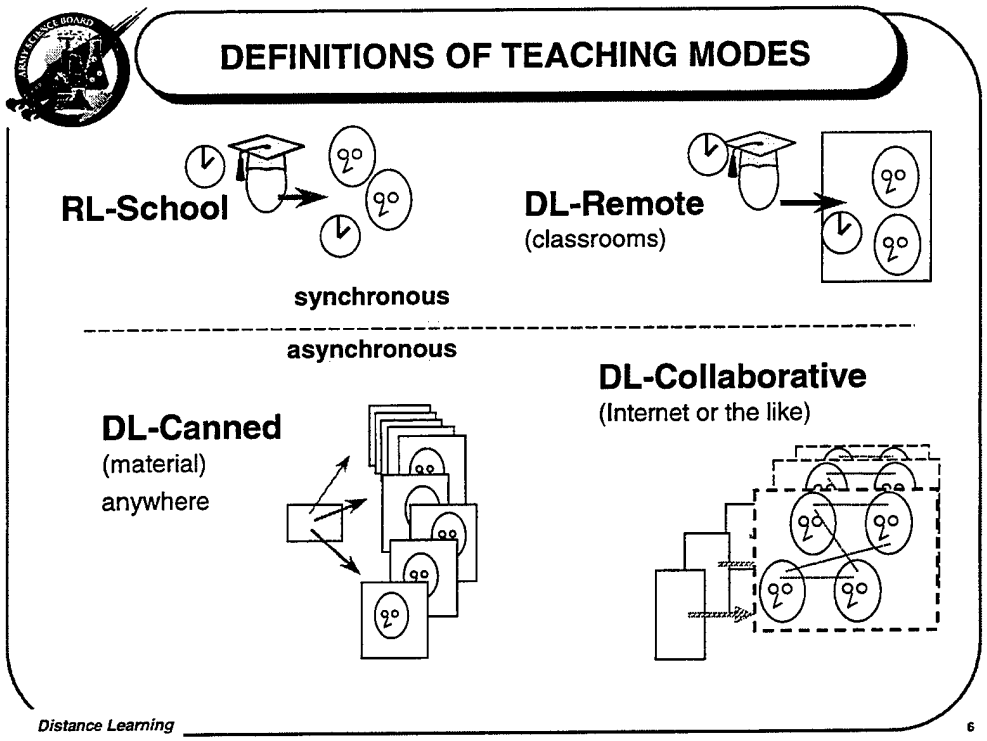
The Army's Training Challenge & Opportunity

Training is an enduring function in the Army. Not including the soldierization of new recruits, about 50,000 officers and enlisted are in training at any given time. The total annual throughput, excluding Basic Combat Training and Advanced Individual Training, is about 180,000. The Total Army (Active and Reserves) strength of 1,000,000 is spread throughout the world; most are in the Continental United States (CONUS). However, about ten percent of the active Army is outside the Continental United States (OCONUS) at sites ranging from urban areas in developed countries to bivouacs in third world countries. All of these soldiers may be involved in individual training at some point in time. Today, training entails moving the soldier to the classroom. This results in attendant costs (TDY, TTHS, etc.) and loss of readiness equivalent to three of the ten Army combat divisions. In comparison, DL offers the possibility of being more cost effective as well as enhancing the Army's readiness by reducing unit personnel turbulence.

The ADLP gives a functional definition of DL; it explains what DL is intended to do, not what it is. The Panel interpreted this functional definition as a way to instruct the soldier in the manner least disruptive relative to unit readiness. DL is a way to deliver education using the most appropriate means available: harnessing the information revolution, implementing affordably and leveraging all financing methods – buying, leasing, establishing partnerships and any others.

Distance Learning is not a panacea for the Army. For example, the conversion of a civilian into a Soldier is far beyond the scope of any present DL technique. *Therefore, soldierization and socialization within the Army's environments in BCT and AIT were not considered for DL in this study.* The Panel believes that DL has progressed and is advancing so rapidly, that harvesting the full benefits demands a cultural change within the Army. This is not a problem peculiar to the Army. For instance, universities and industries have taught for ages under the old, standard paradigm where platform instructors teach students by the method of listen and learn. Most people are a product of this type of education, so this paradigm does work. Nevertheless, there are two factors that call upon the Army to change: new modes allow incredible varieties in learning, and the Army can no longer afford the luxury of RL in terms of money or readiness. Because the implementation of DL and its management demands a cultural change, bold leadership is as important as providing the necessary resources.

The Panel believes DL is capable of providing cost transfer of $114M & savings of 10K man years (MY).



Definitions of Teaching Modes

RL: Residential Learning; DL: Distance Learning, synchronous and asynchronous.

RL-Schools - The traditional method of instruction; bringing the students to the teacher in dedicated facilities. This enhances interaction between students and teacher. Disadvantages of this mode include difficulty of scheduling; loss of troops from unit; and TDY costs. If RL-Schools were somehow eliminated in favor of DL modes, the savings would accrue to a variety of accounts, not all of which could be used to pay DL costs.

DL-Remote (Classrooms) - Live transmission of a lesson from the instructor's classroom to satellite classrooms. This can involve two way video and audio for maximum interaction between students and teacher. Alternatives range down to one way video (high bandwidth) and two way audio (low bandwidth) or similar feedback mechanisms. The video signals can be transmitted via satellite or cable, while the audio can go over ordinary telephone lines. Both of these modes are synchronous, occurring in real time with the instructor present.

DL-Canned (material anywhere) - The material of the lesson is fixed (canned), the earliest DL mode. Examples are the correspondence course, textbooks and self-paced texts. Modern transmission modes include CD's, videotapes, and the like. This is probably the most inexpensive mode over the life cycle of instruction.

DL-Collaborative (Internet or the like) - There are interactions between instructors and students, between a student and 'intelligent tutor' (embedded in the instructional medium), or among students. Presently, this is the most expensive mode, but improvements in technology are likely to continue to drive the costs down.

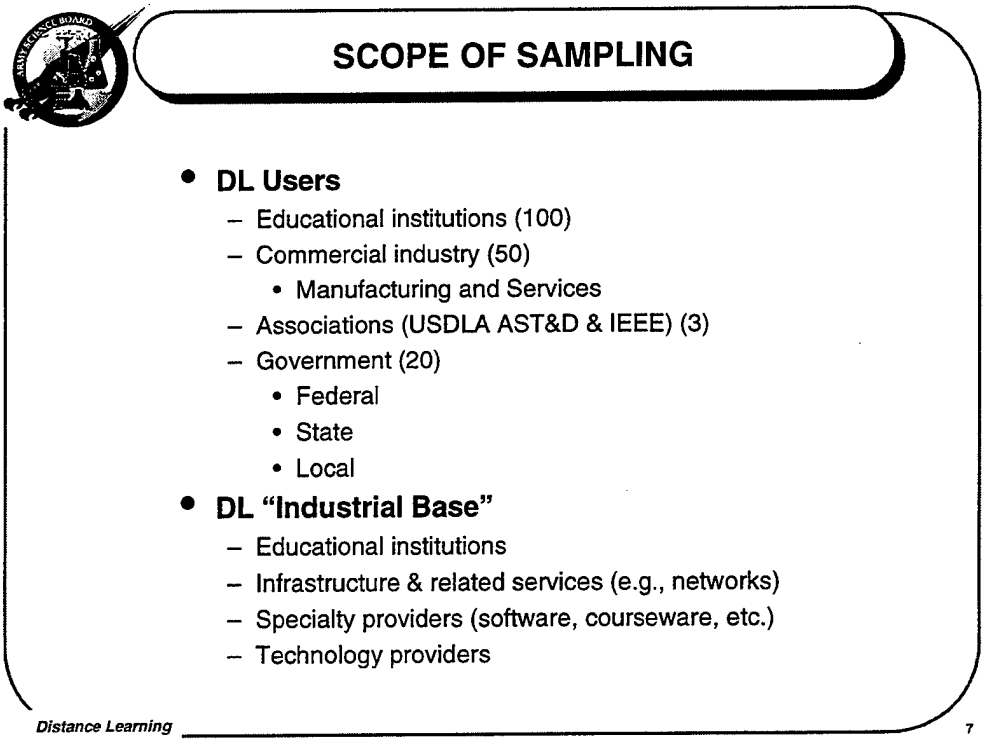
Both DL – Canned and DL-Collaborative are asynchronous, occurring anytime, anywhere, with the instructors piped in through some media, normally at the convenience of the student.

The Panel's view of distance learning includes a DL intellectual framework, which is the basic structure for supporting decisions about learning. Students are Soldiers of the Total Army and represent all ranks, both enlisted and officer. These students bring highly variable individual attributes to the learning task: prior knowledge, learning skills, and learning motivation. Learning objectives consist of what the Army wants the students to learn, under what conditions, and to what standards. Learning objectives are a major driver of all other decisions about DL.

The learning/educational framework involves decisions about elements that directly affect the learning situation. The teacher/surrogate includes traditional teachers in a classroom, viewed through one-way or two-way video in a remote classroom, or the individual who grades and comments on correspondence coursework or responds to Internet queries. It includes a tutoring function that is embedded in computer-based courseware (CW) and student peers who are linked with each other for purposes of joint study. CW is the curriculum or subject matter with which the student directly interacts. It can be structured in a variety of ways and conveyed through different technologies and media, such as textbooks and other printed materials, videotapes, CD-ROMs, and computer programs.

The model of interaction involves two decisions: Are there interactions between the teacher and students, among students, or between the computer program and the students? Is this interaction synchronous or asynchronous? The learning environment constitutes the instructional activities assigned to students, such as the type and frequency of homework and quizzes. Evaluation provides feedback on students and courses. Student evaluation measures skill levels at the start of the course, and progress during and at the end of the course. Evaluation of courses is both formative (test/de-bug/fix) and cumulative (effects on students' work performance).

The cost-effectiveness of DL is driven by decisions about enablers: The selection of technologies (e.g., computers, telecommunications), facilities (e.g., classrooms versus the kitchen table), and type of media (e.g., video, computer-based training, intelligent tutoring systems).

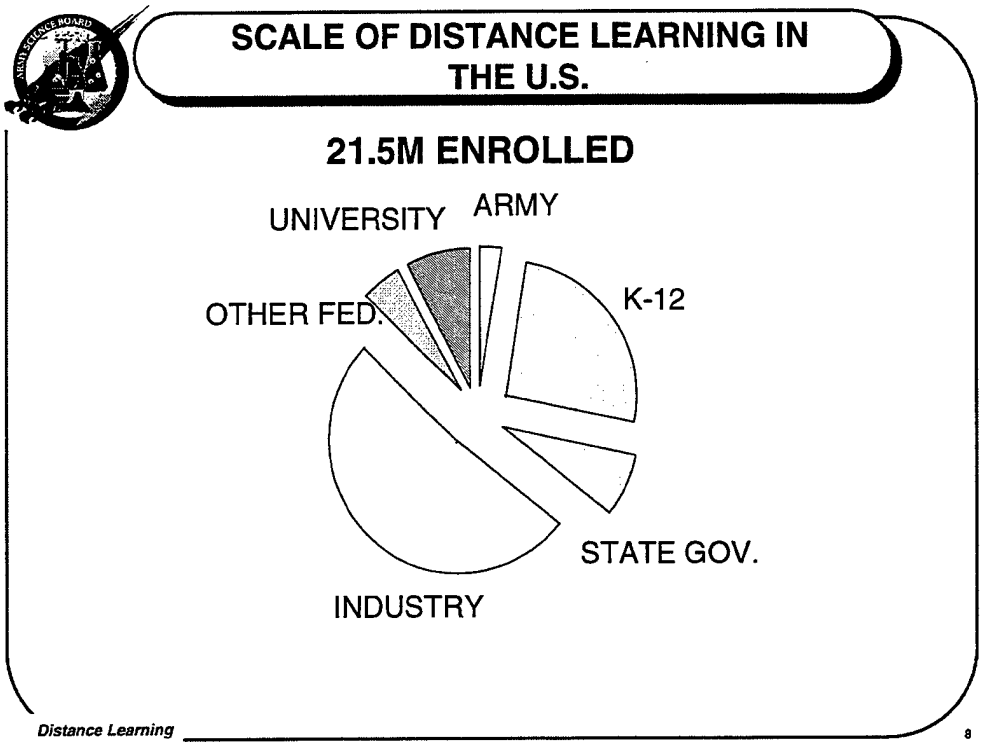


Scope of Sampling

DL is used by many organizations. The Panel sampled industry, academe, and government through site visits, telephone conferences, literature searches, and surfing the Web. The organizations sampled used all forms of DL; some have done so for 25 years. Roughly 100 educational institutions, 50 commercial institutions, 3 associations and 20 government institutions were asked about their experiences with Distance Learning.

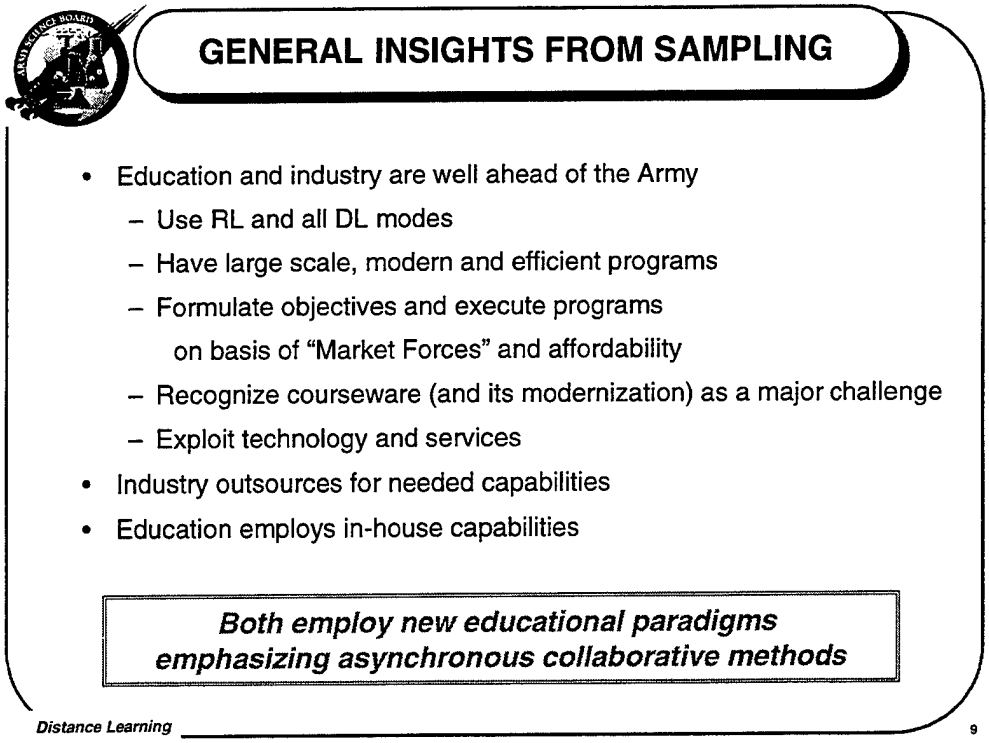
The Panel found that the "Industrial Base" of DL, those involved in providing and improving DL, includes some of the users, particularly educational institutions. For example, universities moving from remote classrooms with one or two-way video/audio to Internet and interactive CD's. These universities purchase or develop specialized software and hardware, effectively conducting Research & Development (R&D) on CW development and specialty software. After product testing and evaluation, they are using their own DL technologies as well as selling them to industry and government.

Other elements of the industrial base include networks, such as Regional Bell Operating Centers (RBOC's), that provide satellite channels and/or fiber optic cabling for a fee. The Panel noted that many commercial software applications now use an embedded interactive tutor to supplement or replace instruction manuals. While such tutors are proprietary, they can be reverse-engineered for use in training courses.



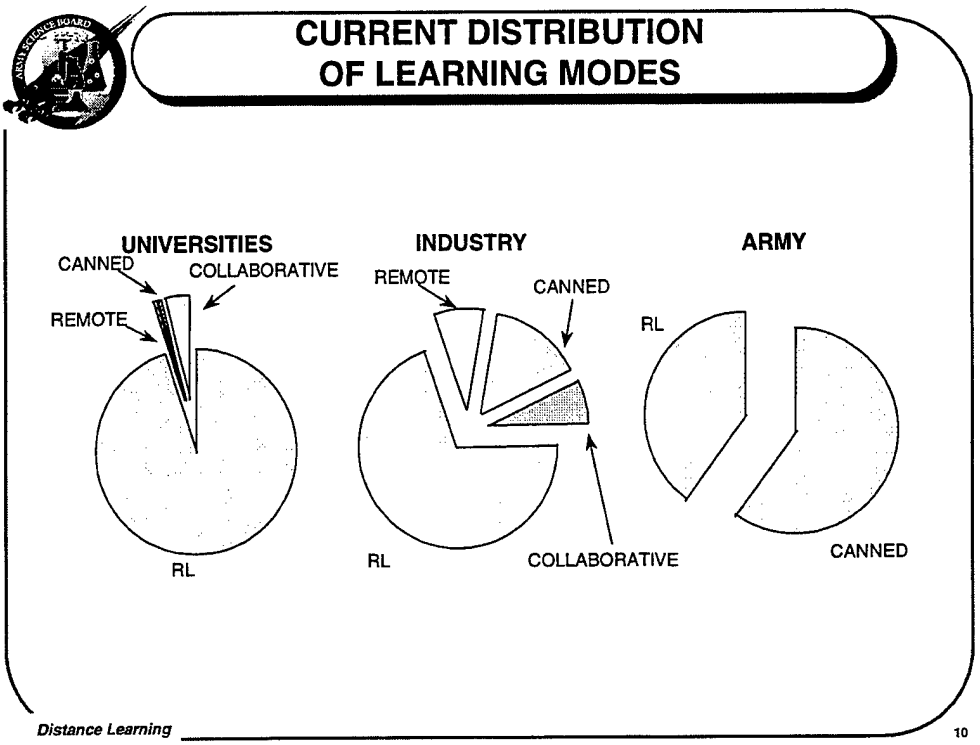
Scale of Distance Learning in the US

Data from the Bureau of Educational Statistics and other sources indicate that approximately 21.5 million people are enrolled in DL classes. The private sector accounts for the lion's share of enrollees, followed by the educational sector (Kindergarten - 12th grade), and state and local governments. Viewed in relationship, the Army's share is rather small and will remain so. The educational sector is expected to grow significantly over the next several years. This in part means that the Army can expect its future recruits to have been exposed to DL in one form or another.



General Insights from Sampling

As previously mentioned, distance learning, in some form, is widely used in the industrial and educational sectors. Choices made in these sectors are largely driven by market and budget forces. Outsourcing is the first choice for new courses, especially in industry. Furthermore, educational technology has guided the development of new paradigms that improve the efficiency and effectiveness of courseware. In other words, new courses are often designed based upon learning principles and pre-registration assessments of student needs. Thus there is an intellectual framework for learning that is the basis for the design of new courseware. There is also an "industrial base" that produces courseware for the mass market. Schools, such as the University of Kansas, have established centers that support the development of distance learning courses. The center supplies equipment, software, and expertise to professors who are interested in offering DL courses. Courseware creation can be laborious and expensive, despite the fact a number of authoring applications have been developed to reduce this cost. Both sectors employ new educational paradigms emphasizing asynchronous collaborative methods.

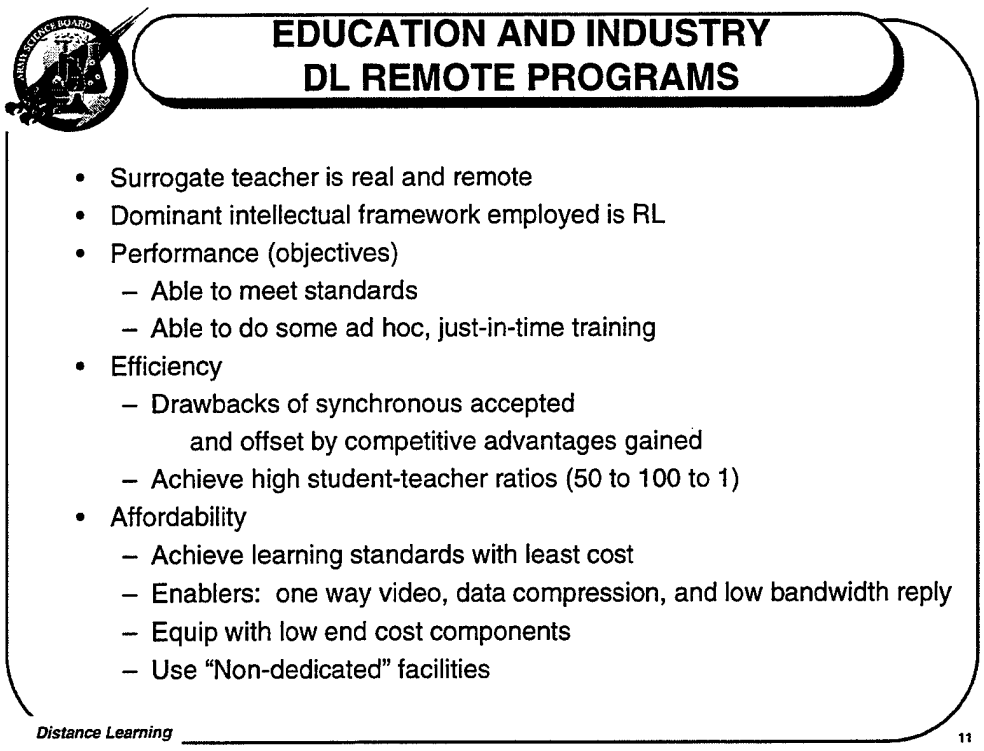


Current Distribution of Learning Modes

Distance learning is growing rapidly in both universities and industry. Currently, universities are still teaching largely in a residential mode. However, research, especially in the areas of Computer Science and Learning, is fueling the rapid growth of DL. Universities have also had a tight coupling with the Internet and have been recently exploiting this in order to provide DL. Therefore, the Panel expects to see web-based DL repositories. There are a growing number of universities and consortia offering a substantial number of on-line DL courses and degree programs. Examples include the California Virtual University, California State University, The Western Governors' University, and The University on-line. The Stanford Research Institute has reported the California Virtual University will offer 9,000 courses by 1998.

A similar growth can also be observed in industry, although the delivery modes at present show different proportions. A recent study reported by the American Society for Training and Development (ASTD) provides data on the percentage of training hours by delivery system. The study shows that computer-based training budgets are on the rise, especially for off-the-shelf CW. The market for multimedia training increased by 53% from 1991 through 1995. In 1996, a report on computer-based training found use of the CD-ROM as a delivery vehicle had increased; and the emergence of CD-ROM and LAN-based delivery systems indicated a trend towards centralized remote DL. The use of the Internet for industrial DL has grown now to 2% of the overall training and is gaining two new users per minute.

The active Army is still mostly taught by RL and the Army Reserve and Army National Guard are still largely on paper-based canned instruction (correspondence studies). The goal of the ADLP is to drastically reduce the proportion of personnel involved in both RL and canned instruction, and to execute a transition to remote classrooms. The ADLP also states an interest in DL-collaborative, although this is not emphasized.



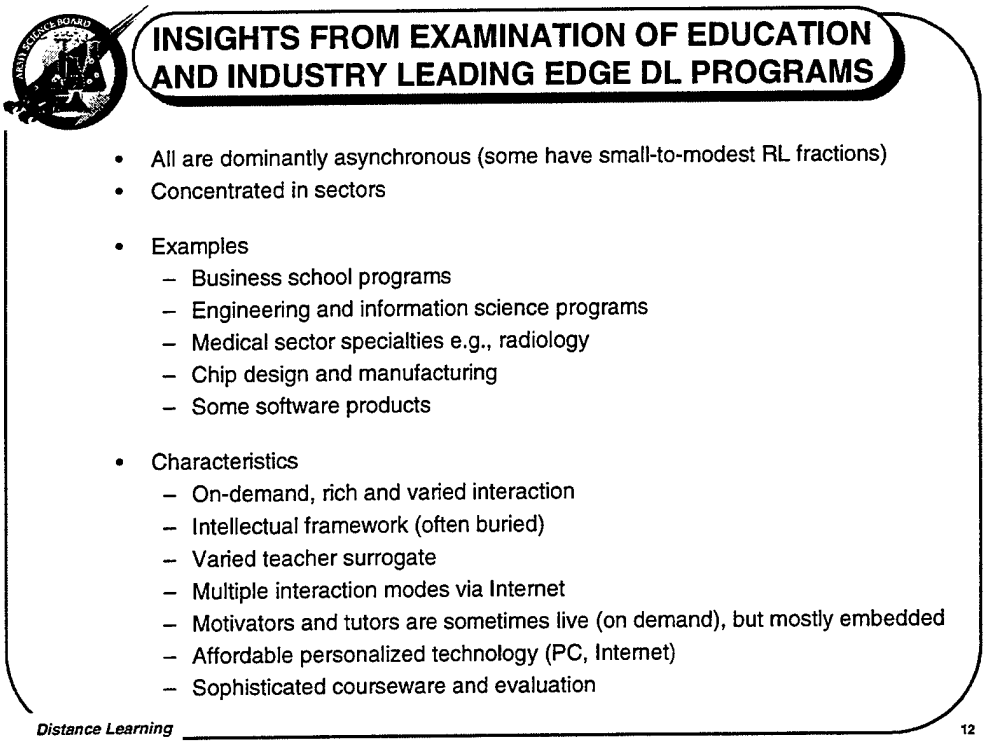
Education & Industry DL Remote Programs

Educational institutions and industry have taken advantage of telecommunications technologies to deliver instruction and training to remote sites. Currently, the dominant foundation of these remote programs is framed in the traditional RL mode, except the teacher and students are situated at different locations.

Relative to universities, this type of remote program facilitates teaching courses to a wider audience, including non-traditional students such as mature adults who are employed full time (this could be the only means of satisfying this group's educational needs). Therefore, a higher student to teacher ratio is achieved.

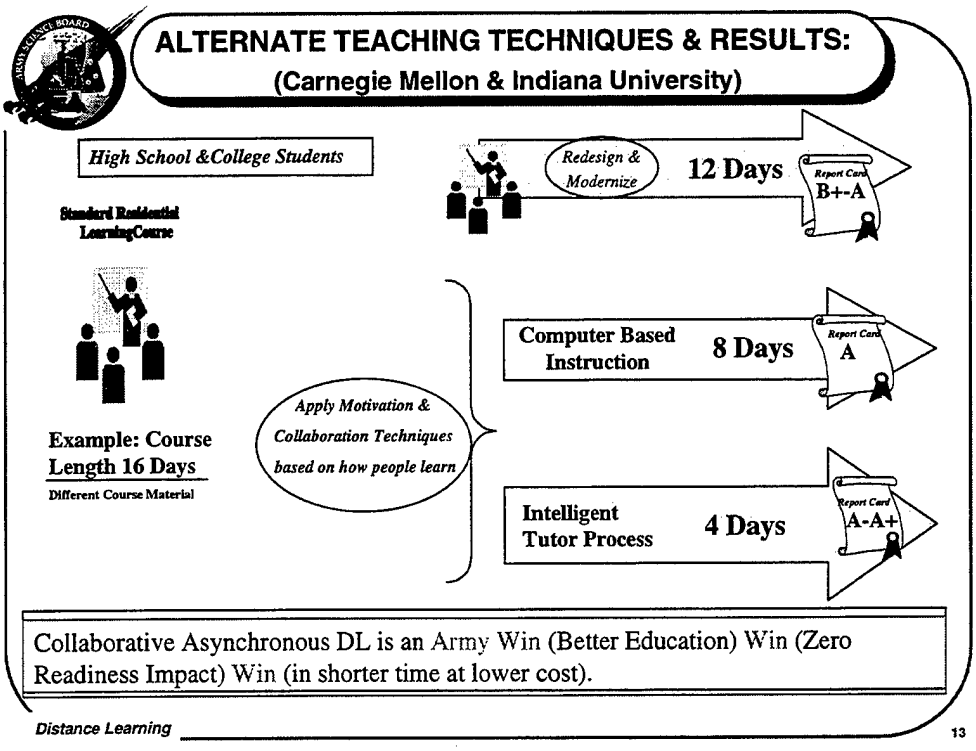
In the case of industry, the remote training program provides a valuable, competitive advantage when it becomes necessary to train employees, in a timely manner, in order to meet minimum skill standards. For example, when a new product is introduced or a quick adjustment in the normal business routine is required, a large number of employees can be educated rapidly on an ad hoc basis by adopting the "just-in-time" (JIT) training concept. Some businesses have adopted this method of remote training by establishing a network of low-cost facilities where employees can be trained without leaving the workplace. A good example of this is the network of "classrooms" established in automobile dealerships.

Even though this type of remote program is synchronous by nature, the drawbacks are offset by the competitive advantages it provides. For example, the start-up costs of the program are comparatively low when consideration is given to the number of students the program can reach. The enabling technologies -- one-way video, data compression, and low bandwidth reply -- are readily available and widely used commercially.



Insights from Examination of Education and Industry Leading Edge DL Programs

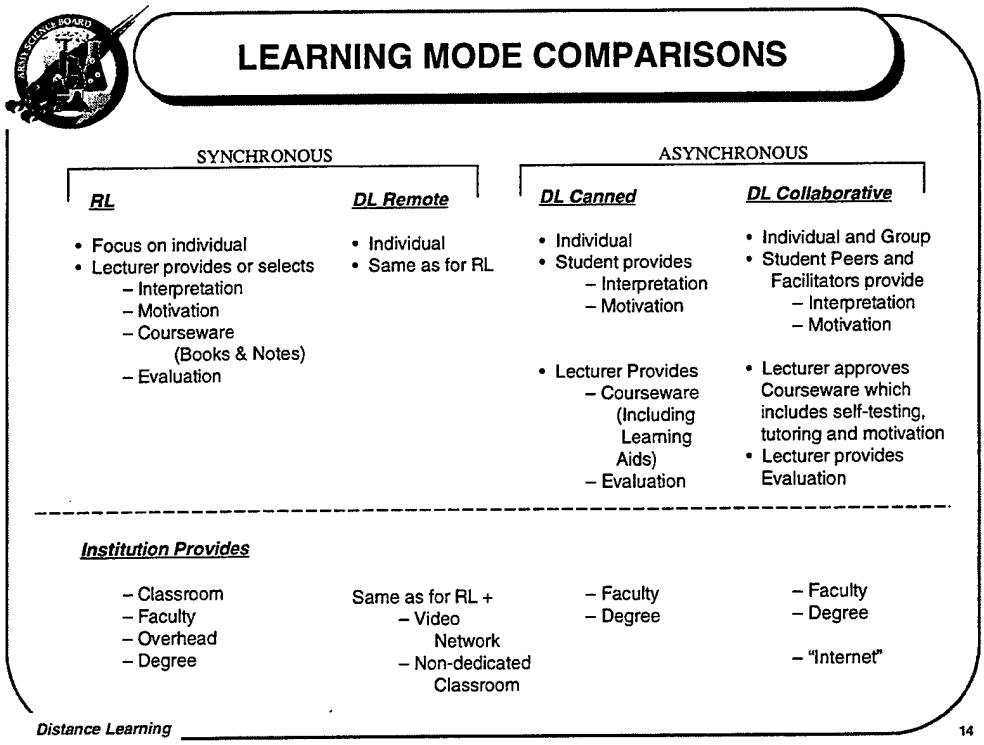
The leading edge DL programs in education and industry are mostly asynchronous and, thus, predominantly DL-Canned or DL-Collaborative. These programs are concentrated in a few relatively technical occupations, such as business school or medical sector specialties. These programs tend to use affordable, personalized technology, like personal computers and the Internet. Generally, they use sophisticated computer-based CW with a student focused intellectual framework. Leading edge DL programs are on demand -- available when the students need them. They can be accessed through multiple interaction modes, such as teacher with student and student with student. They employ highly developed computer-based tutors. The more advanced leading edge DL programs tend to be supported with digital libraries, and evaluations of the student's progress relative to learning objectives.



Alternate Teaching Techniques & Results (Carnegie Mellon & Indiana University)

This chart reflects the advantages provided through redesigning and re-engineering the way the student is taught. For example, an existing RL course is examined for critical tasks and then modified to reflect these objectives. It is then updated to reflect current policies, regulations and laws. Through performing this process, the universities have achieved between 25%-30% reduction in course length. This is independent of the type of media selected for the final output - updated RL courses, Computer Based Instruction (CBI), etc.

The Carnegie Mellon University (CMU) Human Computer Innovative Interface Lab, redesigns courses using a systematic approach to training, similar to the Army's Systems Approach to Training (SAT). CMU re-engineers the course and applies techniques emphasizing how students learn. Enablers such as the Internet or Chat Room, are provided for students to collaborate with each other. Only after applying this process does CMU select the output media for the course. In this case, CBI is used as an enabler. Thus, the result is an additional savings in time and an increase of .5 standard deviation in student performance. CMU has also designed Intelligent Tutors for complex courses achieving a 75% reduction from the original course length and an increase of a full 1.0 standard deviation in student performance.



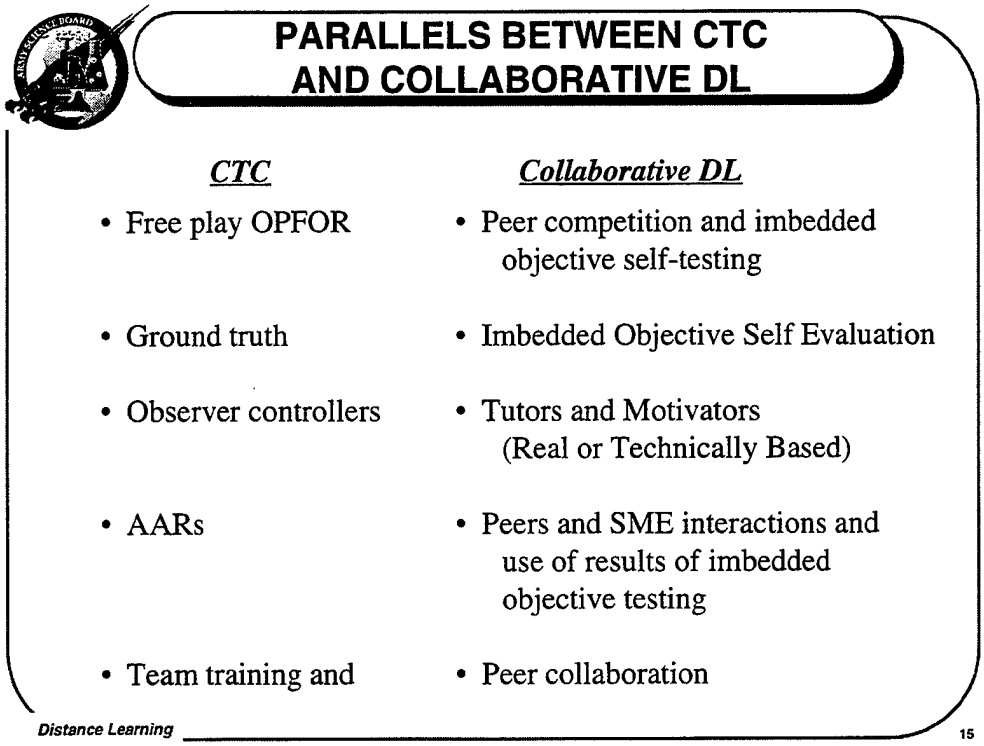
Learning Mode Comparisons

In the synchronous RL mode, the focus is on the individual. The lecturer provides or selects for the student the interpretation, motivations, CW - books and notes - and evaluation. The institution provides the classroom, the faculty, all overhead and awards the degree.

The synchronous DL remote mode is relatively the same as current RL, except the student is exposed to a video network through some non-dedicated classrooms coordinated by the institution.

The asynchronous DL-Canned mode also focuses on the student, however it is the student who provides the interpretation and motivation. The lecturer provides the CW, including the learning aids and the evaluation. The institution only provides the faculty and the award of the degree.

As education transitions to the asynchronous DL-Collaborative mode, a slight modification in focus to both the student and to the group occurs. Students, student peers, and facilitators provide interpretation and motivation. The lecturer approves the CW, which includes self-testing, tutoring, motivation, and evaluation. The institution provides the faculty, and awards the degree, but the Internet or Internet like media delivers the instruction.



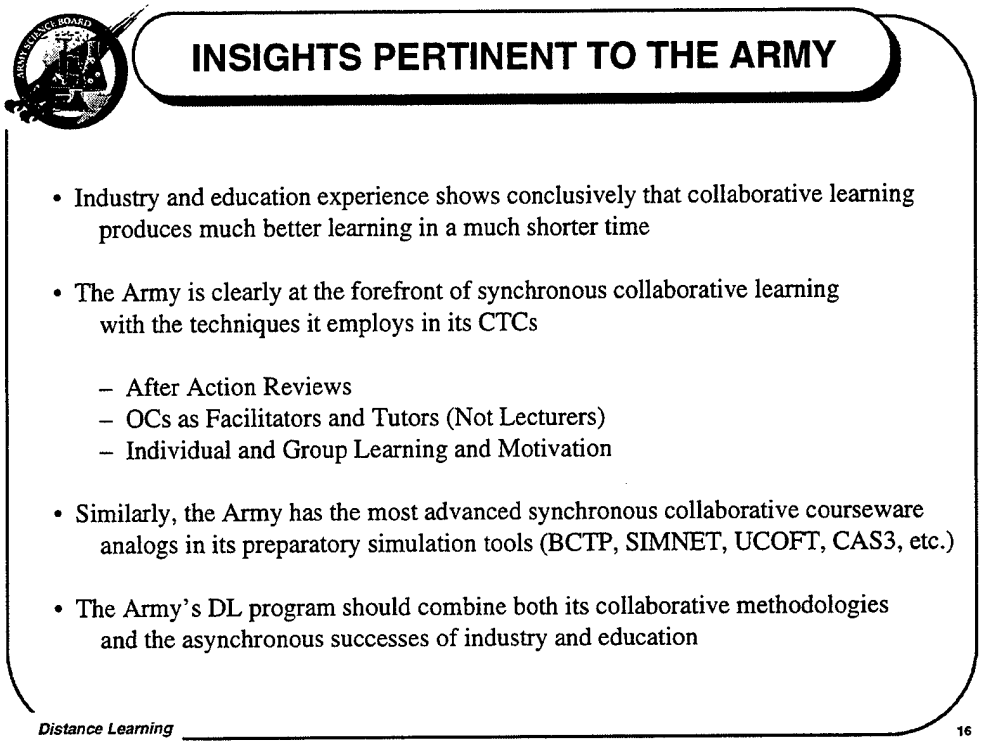
Parallels Between the Army's Combat Training Centers (CTCs) and Collaborative DL

To determine an appropriate framework, the Panel reviewed leading edge programs within the Army, which might serve as examples to provide guidance for the ADLP. Close examination reveals interesting parallels between the methods of the Army's Combat Training Centers (CTCs) and the teaching/learning practices of universities and industries. As an example, the Army's Observer Controllers have a function similar to that of university's tutors. This chart summarizes the pairings of similar functions in the Army with those in academic and industrial establishments. The Army and the civilian sector have a great deal to learn from each other and will achieve mutually beneficial gain through collaboration in distance learning.

Although there are many similarities between the operations of the CTCs and the teaching/learning methods of universities and industries, there are also some fundamental differences, especially when the functions relate to DL. The CTCs, by nature, operate at fixed sites and in a synchronous mode following prescribed schedules. Universities and industries, on the other hand, have developed and are utilizing a delivery mode of teaching to distributed sites adopting both synchronous and asynchronous modes (allowing students to learn on their own schedule). When DL is judiciously applied, it can lead to substantial training, readiness enhancement and cost savings.

For DL the intellectual framework represented in the CTCs is more leading edge for training purposes than current training practices in industry and/or education. However,

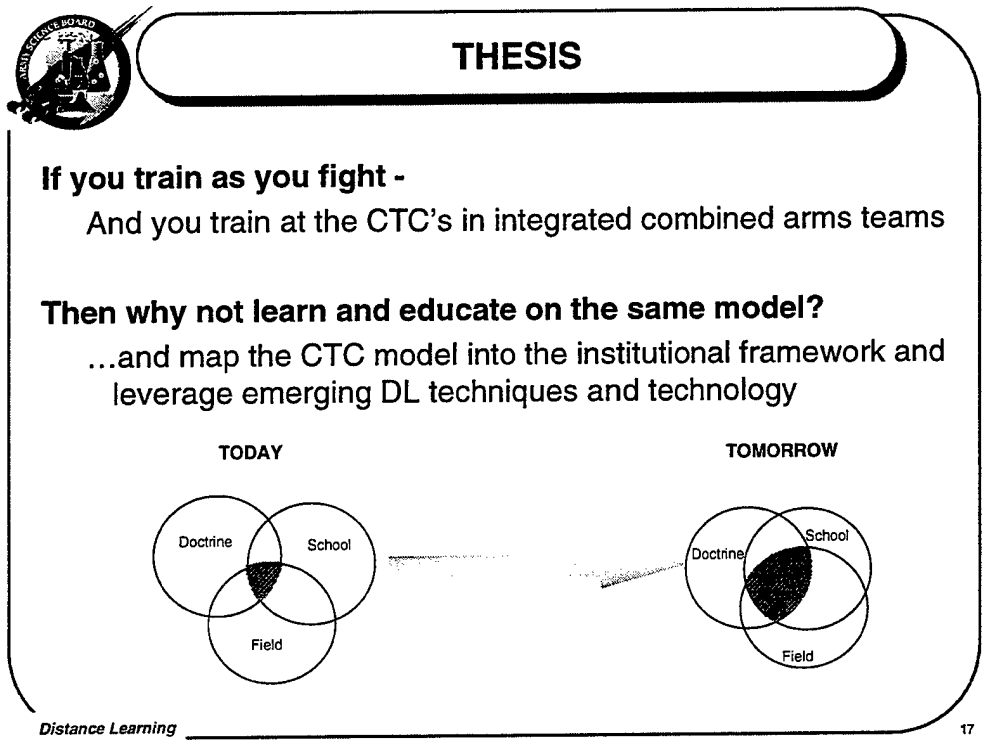
the best practices of industry and/or education, through asynchronous applications, are less costly, more widely distributed and should be combined with the collaborative techniques employed at the CTCs. Further, a strategy must be developed for acquiring technologies that change rapidly and which also deals with obsolescence for CW and technology.



Insights Pertinent to the Army

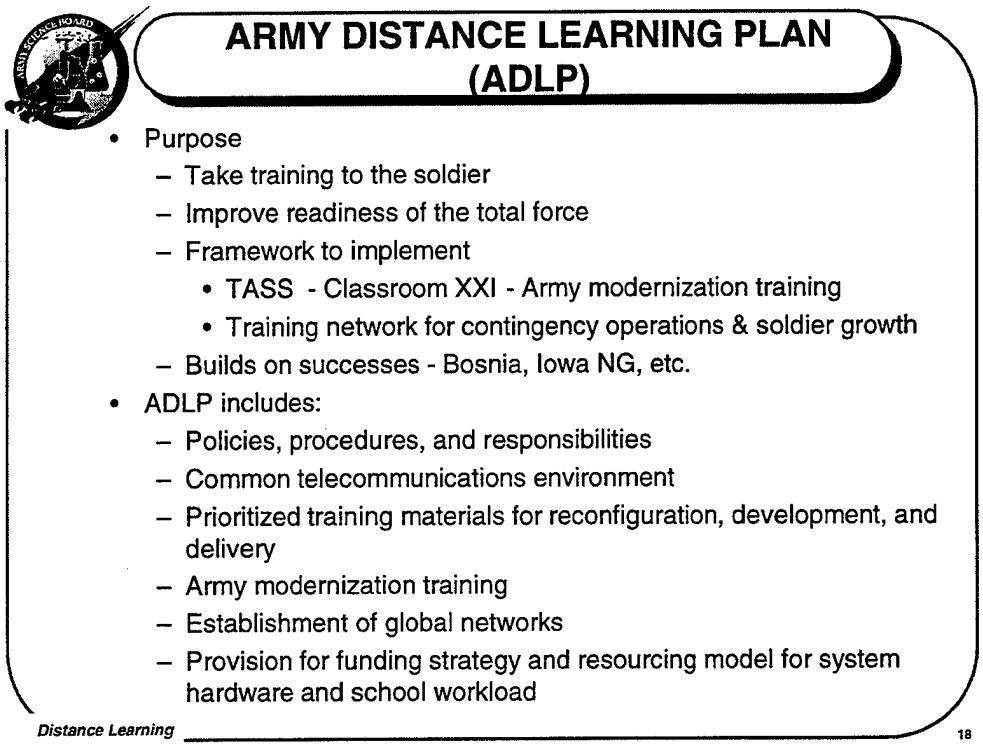
Industry and Education experience shows conclusively that the collaborative learning method produces a superior learning environment. The DL-collaborative method provides superior education within a considerably shorter time frame. The Army is at the forefront of applying the synchronous collaborative learning paradigm through its CTC techniques. The employment of After Action Reviews (AARs) and Observer Controllers (OCs) create individual and group learning and motivation. The Observer Controllers function as facilitators and tutors, not lecturers, thereby providing orchestration to the learning environment. Similarly, the Army has the most advanced synchronous collaborative CW analogs in its preparatory simulation tools, demonstrated in the Battle Command Training Program, Simulations Network, Unit Conduct of Fire Trainer, and the Combined Arms & Services Staff School. The ADLP should combine both its collaborative methodologies and the asynchronous successes of industry and education.

The DL framework is composed of students; learning objectives; teacher/surrogate; CW; model of interaction; learning environment; evaluation; and the enablers of technology, facilities, media, and so forth. The enablers, for example – technology – should be the best of the available options to facilitate subset testing for cost-effectiveness.



Thesis

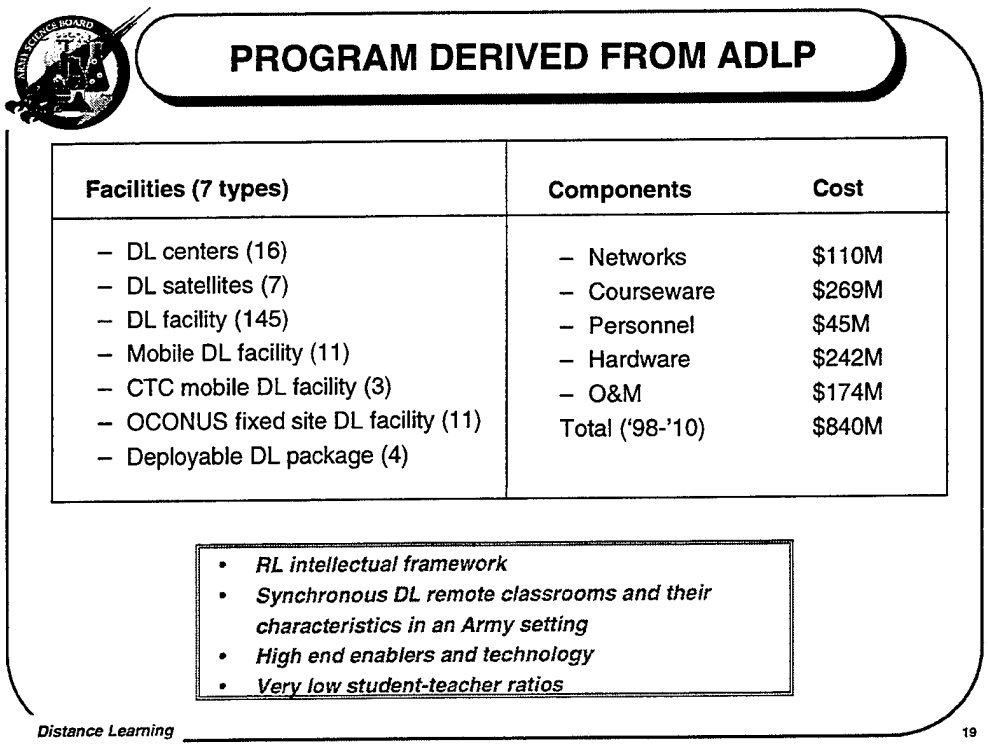
The education programs of the Army are not isolated. These programs are required for the Army's development of doctrine, taught in the Army's RL Schools, and trained by units in the field. The Army has a great deal of experience in delivering high quality training to integrated combined arms teams at the CTCs. The civilian sector has some parallels in this field, but the Army clearly excels. The Army should take advantage of this strength and combine it with rapidly developing telecommunications technologies to structure an exceptional DL program. The Panel recognizes the intersection of Doctrine/School/Field is kept small because of the turbulence in Army assignments, which has no parallel in the civilian sector. In time of war, of course, the three areas on the Venn diagram merge, and the area of intersection grows larger.



The Army Distance Leaning Plan (ADLP)

The ADLP proposes to deliver education to the soldier at the right place and right time by the use of DL. The main purpose of the plan is to improve readiness of the Total Force and it enables training the Total Army to the same standard. The ADLP will support Army Training XXI (Army training that corresponds directly to Force XXI implementation) and be included in the Total Army School System (TASS) by using DL technologies and/or techniques.

The ADLP includes policies, procedures, and responsibilities for implementation. The plan details a specific configuration for hardware and infrastructure as well as details and schedules for course selection, course conversion, and media selection, with their related costs and their projected savings.



The Program Derived from the ADLP

The principal portion of the ADLP transforms some RL into a synchronous DL setting with a heavy emphasis on remote classrooms. Traditional classroom teaching is transferred to remote sites by technologies such as VTT (two-way video and audio or data transmission). To do this, wide bandwidth networks and associated hardware are needed. Remote classrooms with high-end enablers are very expensive. The plan leans heavily on VTT, robust electronic networks, and electronic training platforms. While 42% of the total cost of the plan, $840 million, is projected for networks and other hardware over the 13-year funding profile, only 32% is allocated for course conversion. The remaining funds are designated for personnel, and operations and maintenance (O&M). The current draft of the ADLP is based on a traditional RL framework that is transformed to a synchronous DL remote classroom mode.

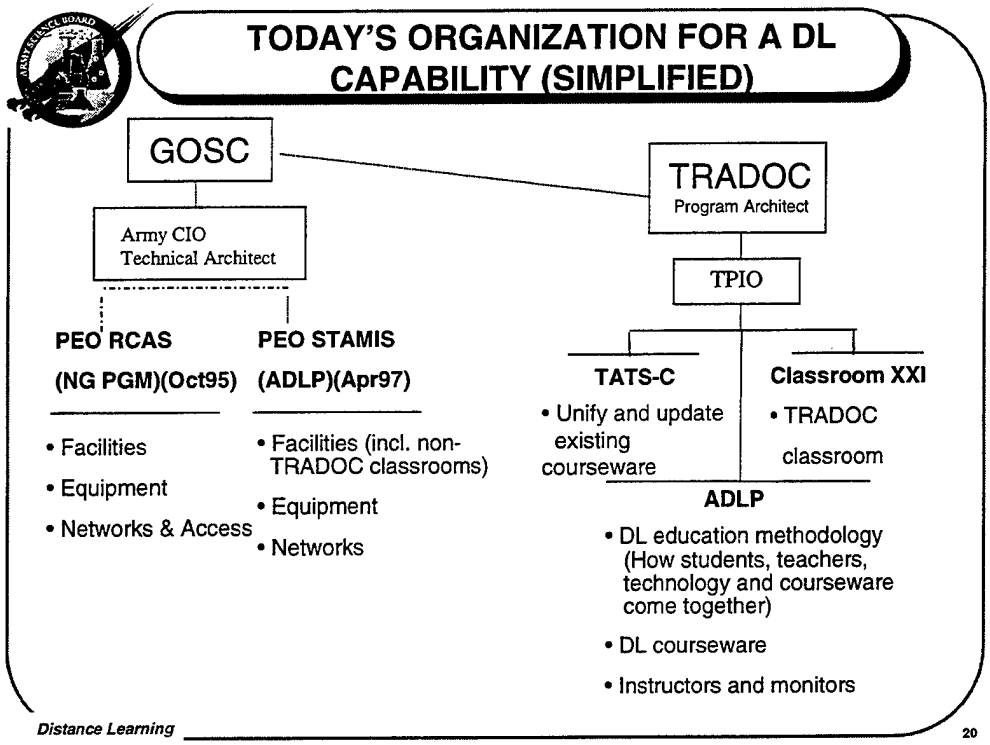
Although not specifically written in the plan, in concept, the Army's DL program supports the continuance of the classical RL framework – the classical paradigm. Students may not be physically situated in the same room as the instructor, but they will observe the live instructional delivery. The students will see the image of their instructor through video screens, with teacher-student interaction occurring via two-way video teleconferencing technology. In the non-resident TASS DL classroom configurations, backup instructors and/or assistant instructors will also be present. Evaluation of the student's progress is through standard classroom evaluation techniques, such as paper-and-pencil tests.

This model requires expensive, high-end technology (two-way video) and physical classrooms where students gather at remote sites. The ADLP staffing model proposes one teacher instructing the course with an assistant (monitor/ teacher) for every 15 students at each remote site. This produces a very low teacher to student ratio (1: 7.5).

Five hundred twenty-five courses are projected for conversion to multimedia, with a mix of two-thirds RL and one-third DL for each course. The course model does not project any course delivered completely via DL. The 525 courses were selected through a careful process from about 2,500 courses. The process consisted of consulting with the TRADOC Proponent Schools and AC/RC commands to evaluate each course relative to factors of: readiness enhancement; MOSQ density; course quotas/seats and delivery media. Task analysis within each course consists of an effort to eliminate redundancy, and to match resident, non-resident and correspondence options to achieve one standard. Programs of instruction are then prepared and Army Training Support Packages (TSP) are completed. This initial process is culminated through adaptation into the Army's Doctrine and Training Digital Library (ADTDL). After completion of these steps, the course will be developed to accommodate appropriate DL technologies. This entire process may be sequential or concurrent.

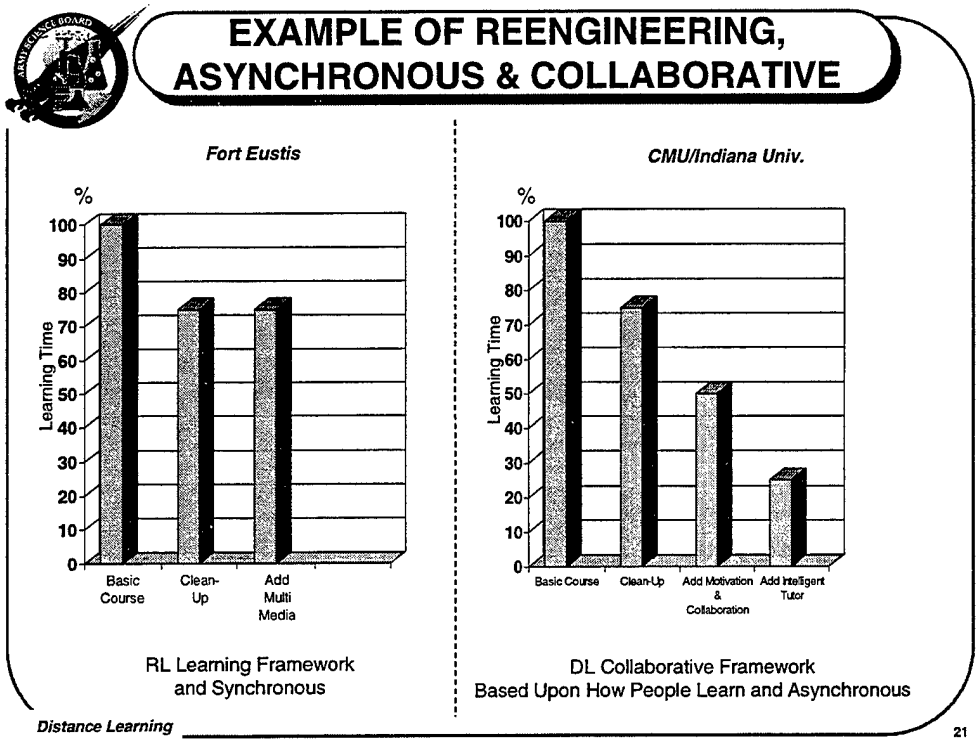
The funding for the program, especially the CW conversion component, is stretched over 13 years because of a shortage in funding and subject matter specialists. The result is that the savings associated with even the proposed modest shift from RL to DL, which the program envisions, cannot be reaped for many years.

The Panel views the ADLP as applying primarily a RL Intellectual framework. The Army setting promotes synchronous DL remote classrooms with their inherent characteristics. The ADLP emphasizes high-end enablers and technology against a very low student-teacher ratio.



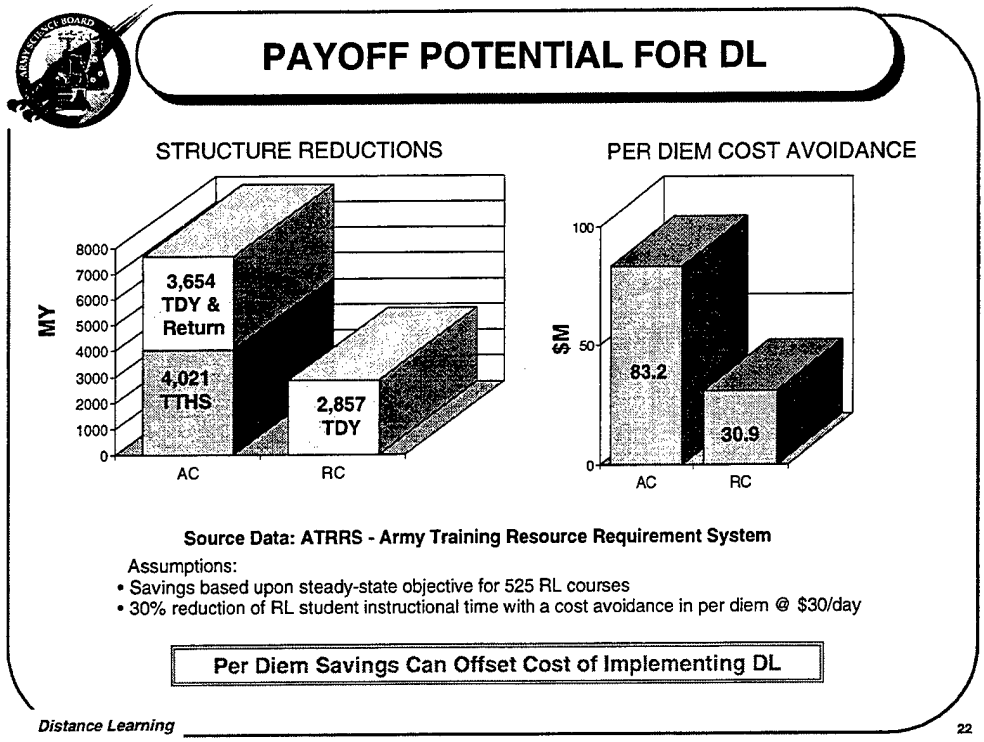
Today's Organization for a DL Capability (simplified)

The Army manages the DL program via a diffuse management process. The Army's CIO and technical architecture are managed through two separate Program Executive Offices. A General Officer Steering Committee (GOSC) provides general advice to the Program Executive Office (PEO) for Standard Army Management Information Systems (STAMIS). PEO STAMIS has the responsibility for the infrastructure portion of the ADLP. Another PEO has the responsibility for the Reserve Component Automation System (RCAS), a National Guard and Army Reserve system. The ADLP program architecture falls under the Commanding General (CG) Training and Doctrine Command (TRADOC). TRADOC has the overall control of the funding for the CW conversion. Both PEOs acquire facilities, equipment, and network access for the respective clients. TRADOC is responsible for three DL activities: TATS-C (Total Army Training System-CW), Classroom XXI, and ADLP. A separate Defense Advanced Research Projects Agency (DARPA) program, Simulations in Training and Readiness (SIMITAR), was funded for the last few years to explore simulation capabilities with DL applications. It appears, however, that this program will cease when current funding expires because a major Army organization has not expressed willingness to provide further support.



Example of Reengineering, Asynchronous & Collaborative

This chart shows the examples demonstrated through course redesign at Fort Eustis, Carnegie Mellon University (CMU) and Indiana University side by side. The savings are not achieved from the transition of the CW onto a Computer Based Instruction (CBI) platform. The savings are achieved by performing a functional process analysis of the critical learning objectives for the course, applying motivation and collaboration techniques, and, when needed, developing Intelligent Tutors to assist the student in learning the material.



Payoff Potential for DL

As far as the Total Army is concerned, course conversion to DL saves dollars. The faster the conversion, the more money saved. Readiness is improved as well.

The current ADLP calls for the conversion of 525 RL courses from 2500 mixed RL and DL courses. The TRADOC cost analysis projects a total cost of $839.7M projected over a 13 year funding profile. The annual cost ranges from $37.5M to $93.5M with an average annual cost of $64.6M over the life of the program. The savings projections involve complex formulas to determine per diem, travel, permanent change of station (PCS), lease and usage fees (Tele-training Network TNET and Video Tele-conferencing VTC), reduced student load and instructor training and certification. Each category of savings was computed to determine overall savings/cost avoidance, assuming approval of the full funding requirement, for a total of $912.4M over the 13-year program.

The Army's projected cost for CW conversion totals $268.9M. Thirty-one courses are projected for annual conversion from 1998 through 2002. The cost of this conversion ranges from $426.5K to $690.2K per course, with an average of $594.4K per course. From 2003 through 2009, forty-seven courses are projected for annual conversion. The cost of this conversion is estimated from $212.6K to $760.8K per course, with an average of $523.4K per course. During 2010, which is the thirteenth and final year of the program, the last forty-one courses are projected for conversion, with a cost of $112.4K per course.

If the Army accelerates its current DL program, Total Army - Active, Guard, Reserves - benefits will be realized in both available dollars for reinvestment and Soldier man-years (MY) for mission requirements. Research has shown that transforming a course into a mix of RL and DL applications will yield 30% savings in student instructional time. The Panel has employed this DL estimate from research with a conservative per diem factor for cost and MY formulas:

Per Diem cost avoidance:

$ = (RL hrs.) x (.3 / 36 hrs per wk.) x (7 days) x ($30 per day) x (ATRRS quotas)

Man Year savings:

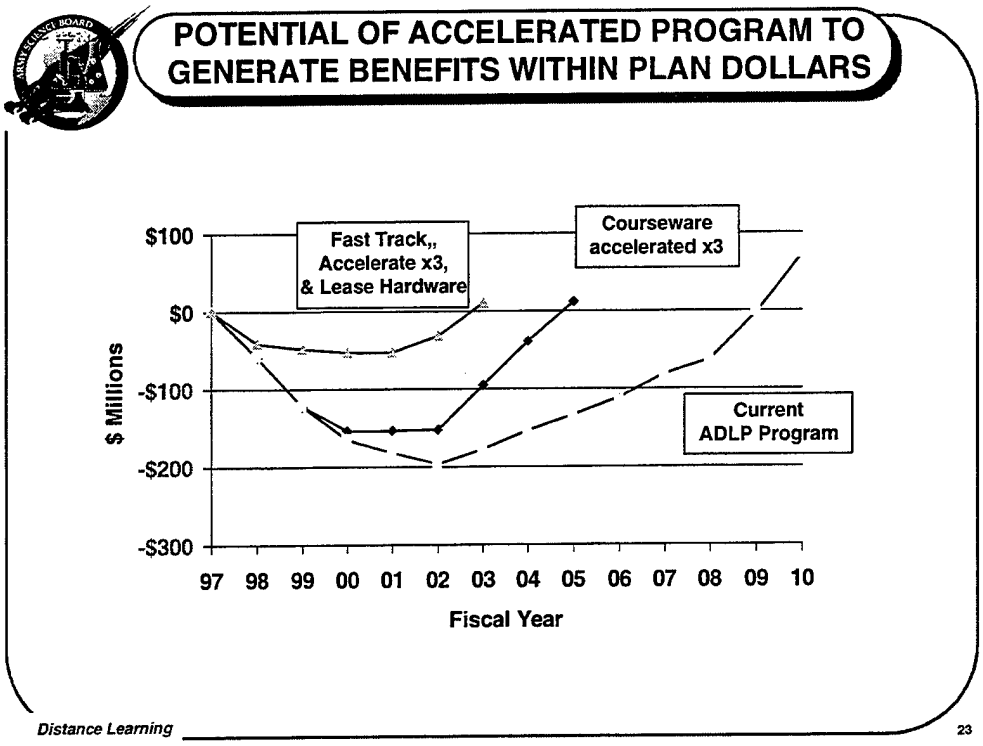
MY = (RL hrs.) x (.3/36 hrs per wk. / 52 wks.) x (ATRRS quotas)

(Where ATRRS quotas are annual throughputs from the Army Training Resource Requirement System (ATRRS)).

As shown, a $114M per year offset against up front investment is possible if the program is accelerated to achieve optimum efficiencies. Additionally 10,532 MYs would be avoided and available to unit commanders for mission requirements.

The conversion of CW, if accelerated to maximize least cost, highest payoff courses, will yield Return on Investment (ROI) in less than three years based on the above mentioned formula (See Appendix G Comparison Table). Structure benefits will be derived from gains in manpower due to less time away from units. The Army used a conservative projection of a 30% DL course reduction against student instructional time as a model. The Panel feels this is too modest an assessment of the DL potential benefit. A higher pay back may be achieved when the savings in student instructional time is determined to be much greater for selected courses. Most importantly, the ripple effect in soldier MY savings for mission performance will be compelling for future force management decisions.

The Panel feels per diem savings can offset the costs of implementing DL.



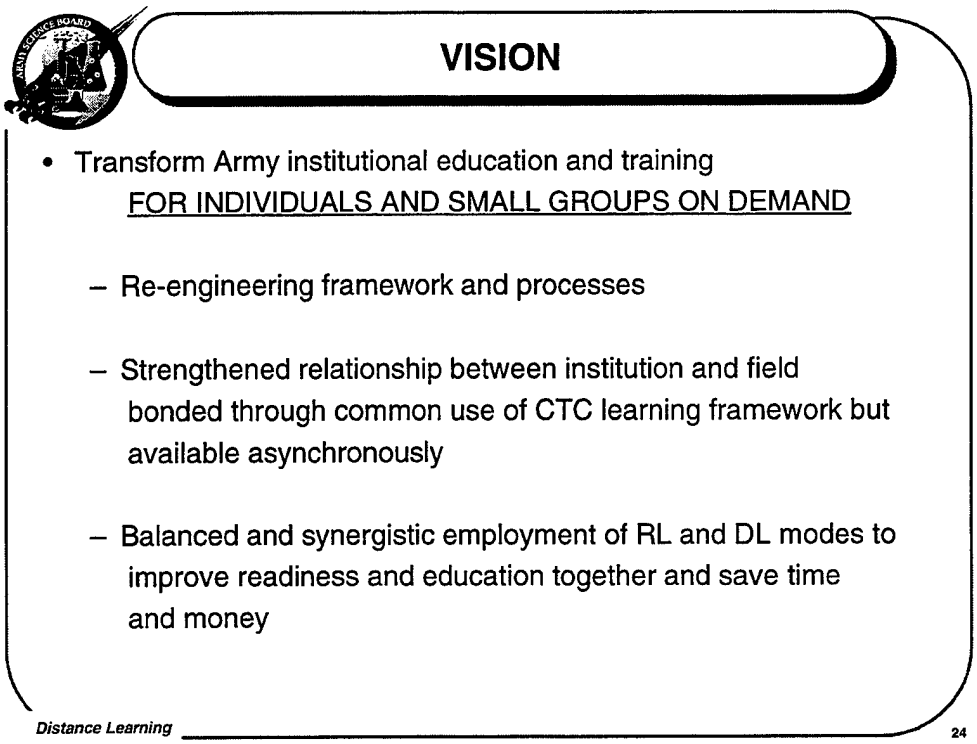
Potential of Accelerated Program to Generate Benefits Within Plan Dollars

Given the high rate of return on the initial 525 course DL capability, it is considered imprudent not to aggressively accelerate the rate of CW conversion. Both the ADLP proponents and the Panel agree that the annual savings can exceed $100 million once the program is in place. This figure illustrates some techniques that could reap major savings for the Army.

The lowest curve reflects the revised DL plan as of June 1997; it is included for reference. The important fact is that the break-even point will not be reached until 2009.

The Panel believes the rate of CW development can be accelerated significantly, perhaps by as much as a factor of three, within the current program budget. This acceleration in the fielding of CW could result in a return on investment of nearly $500M before the year 2005.

Finally, the Panel proposes an approach combining a CW "Jumpstart" with accelerated development and leasing of the hardware to reduce the initial investment; this probably represents an upper bound on what the Panel hopes to achieve. Jumpstart has been developed to reduce the time and money required to produce software; the results are major savings. The leasing of hardware reduces the initial investment, which allows additional resources to be applied to the CW conversion process. As reflected in these recommendations, the Panel recognizes a major change in the approach to training will not be easy; therefore, the Panel advocates the lease approach to increase the Army's flexibility in the early years. This could possibly move the break-even point to the year 2003.



Vision

The Panel recommends the Army take the following actions:

Transform its institutional education and training to focus on individuals and small groups on demand.

Reengineer its framework and processes.

Strengthen the relationship between the institution and the field, bonded through common use of CTC's learning framework, but available asynchronously. Education and Training must be a balanced and synergistic employment of RL and DL modes to improve readiness and education together and save training time and money.

Derive DL solutions for it's varied educational and training needs through the mechanisms of partnerships. Solutions can be integrated from contributions from three classes of partnerships – Financial, Technical, and Instructional.

Leverage non-army or DOD investments.

Exploit a growing DL base for competitive purposes.

Access world class talent from industry, academe and government rather than develop a full or even partial in-house DL infrastructure.

Focus its resources -- people, technical capabilities, and financial means -- on being a smart buyer-partner.

Establish and refine the intellectual framework and technical architecture for DL by applying the best collaborative methods from industry and academe with the CTCs advances prevalent in the Army.

Provide, only where necessary, army unique solutions.

Lease rather than buy to avoid the future legacy system trap for the immediate near term.

Aggressively pursue the use of current and emerging DL capabilities to address its current and probable future challenges.

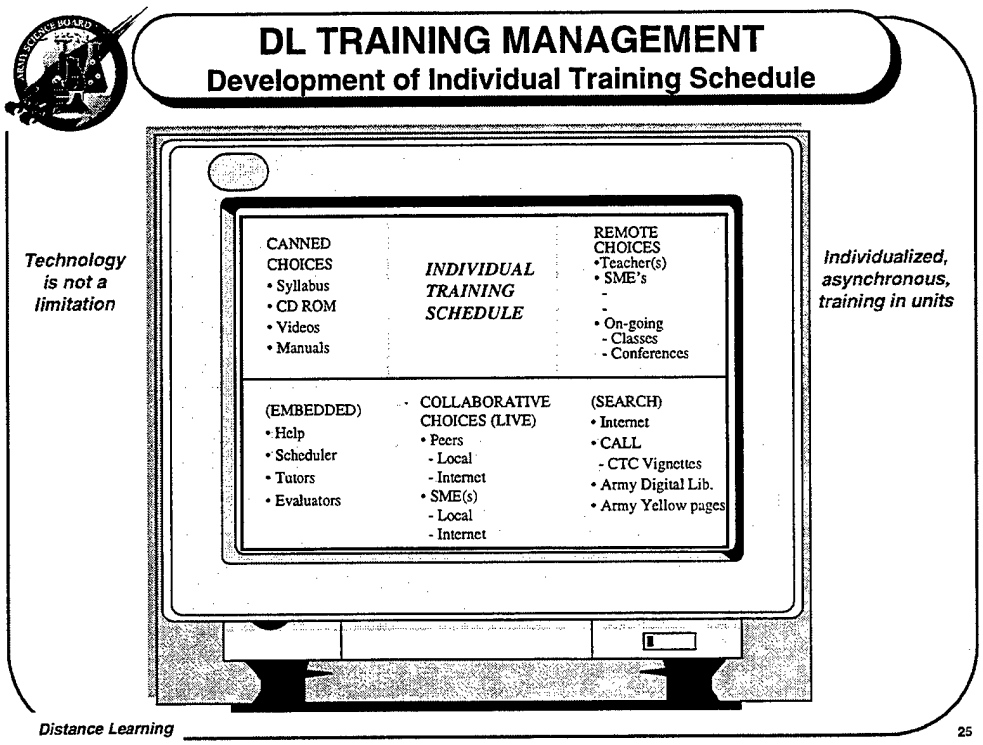
Conduct a set of DL experiments based upon partnerships to establish benefits, costs, strengths and limitations.

Pursue the research to make future DL activities more effective and affordable using commercial and academic sources.

Through external research, establish how people learn in order to improve conceptual, cognitive and motor skills training in the Army.

Establish methodologies and techniques to support learning both individually and in groups (small to large settings).

Be a smart industrial and academic base builder and user of DL capabilities.



DL Training Management -- Development of Individual Training Schedule

Today the development of an individual's training schedule is almost entirely based upon the availability of scheduled schoolhouse courses.

With DL, the training schedule will be based upon the Soldier's availability and is independent of the Soldier's duty assignment location. The key is to design the courses recognizing technology is not a limitation. Ultimately, the Soldier should be able to gain all needed education and training (except socialization and soldierization) through inexpensive, ubiquitous receptors (TV sets, PC's etc.) accessing the course material through a variety of channels (satellite downlinks, internet, snail mail, et al). The course material may resemble present courses, but it could well include CTC's, vignettes and access to digital 'libraries' to permit a construction of training relevant to the individual Soldier's assignments. Several of these modalities will allow student collaboration, asynchronous contact with instructors, and Intelligent Tutors programmed into the course material.

In the not too distant future, the following scenario might take place.

A soldier in a unit is told to complete four segments of a course to qualify as a squad leader. Over the next six weeks, the Soldier only has certain days and hours available. The Soldier's first action is to query the PC to find out which of the four segments he can diagnostically pretest and successfully pass without taking those particular segments.

The Soldier's available days and time for the next six weeks are then input into the computer, and the following questions are asked:

Of the remaining segments, what is going to be available on the net as formal instruction while I am available to view and participate?

Of the remaining segments, what is going to be available on the net as archive/library information while I am available to view and participate?

Of the remaining segments, what elements are available in CBI with interactive tutors?

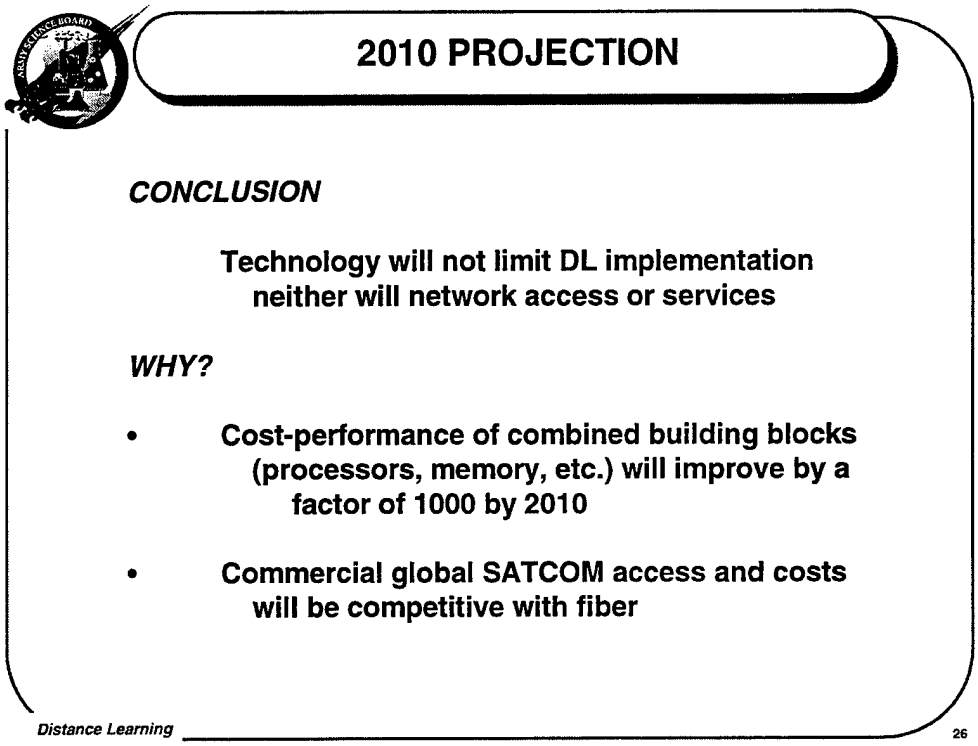
Are any other soldiers in my unit taking any of the four segments and the elements that I am lacking?

Are there subject matter experts (SMEs) in my unit? If not, are any SMEs going to be available over the net or by cable during my available times?

Of the material not declared available in my previous queries, is any of it available in the 'Army Yellow Pages'?

Of the material not declared available in my previous queries, are there equivalent elements available through other DoD, industrial, or civilian feeds that will permit me to qualify?

All of these actions are well within the realm of possibility. The Soldier has prepared his training schedule and is ready to "roll" in less than an hour. There is no need for the Soldier to leave the unit for an extended period of RL.



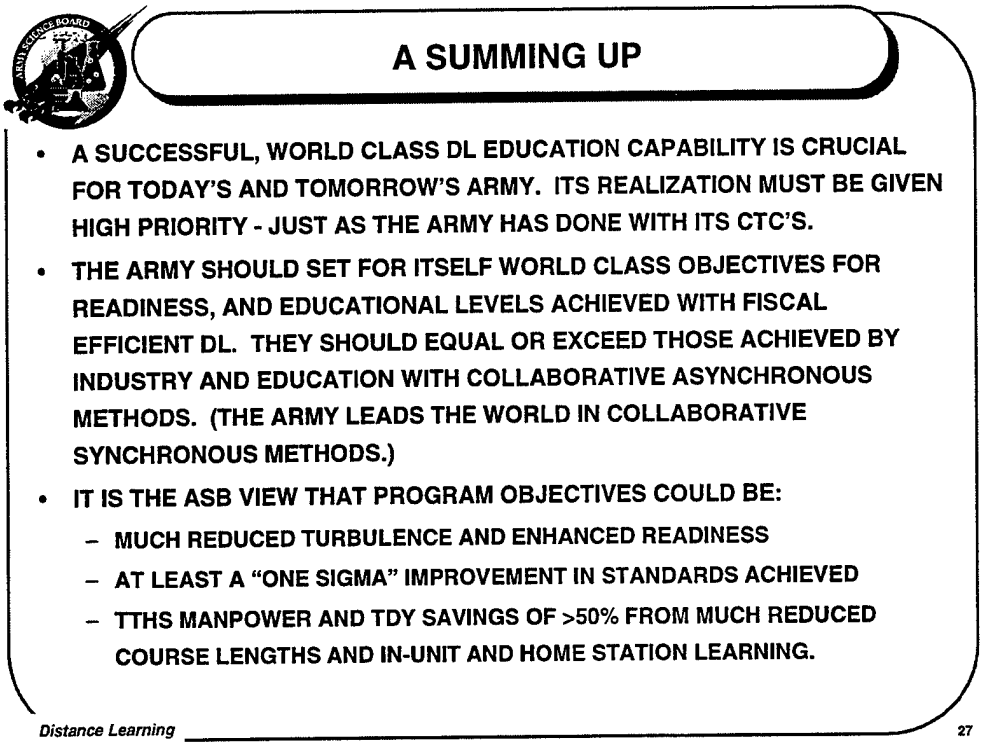
2010 Projection

The implementation of DL will not be limited by technology, and its evolution will not be obstructed by network access or services. The reason is that cost-performance of combined building blocks (processors, memory, etc.) will improve by a factor of one thousand by the year 2010, and commercial global SATCOM access and costs will be competitive with fiber.

The speed and capacity of computer and communications systems has been increasing exponentially for over thirty years. During the decade of 1985 to 1995, the overall performance of desktop computers increased by more than a factor of fifty in both speed and random-access memory capacity, both measures doubling approximately every fifteen to twenty-four months. During the same period, the cost of desktop computers steadily decreased, going down by half every two years. Although there are physical limitations to overcome in the future, current technology trends indicate this exponential growth rate will continue well past the year 2005. At this rate, the desktop system of 2010 will be three orders greater in magnitude than current machines. Given these trends, it is clear the power of computing technology will not limit the implementation of any DL plan. Furthermore, any such plan must assume a process of continual redevelopment and redeployment is required to fully utilize the increasing power of computing technology.

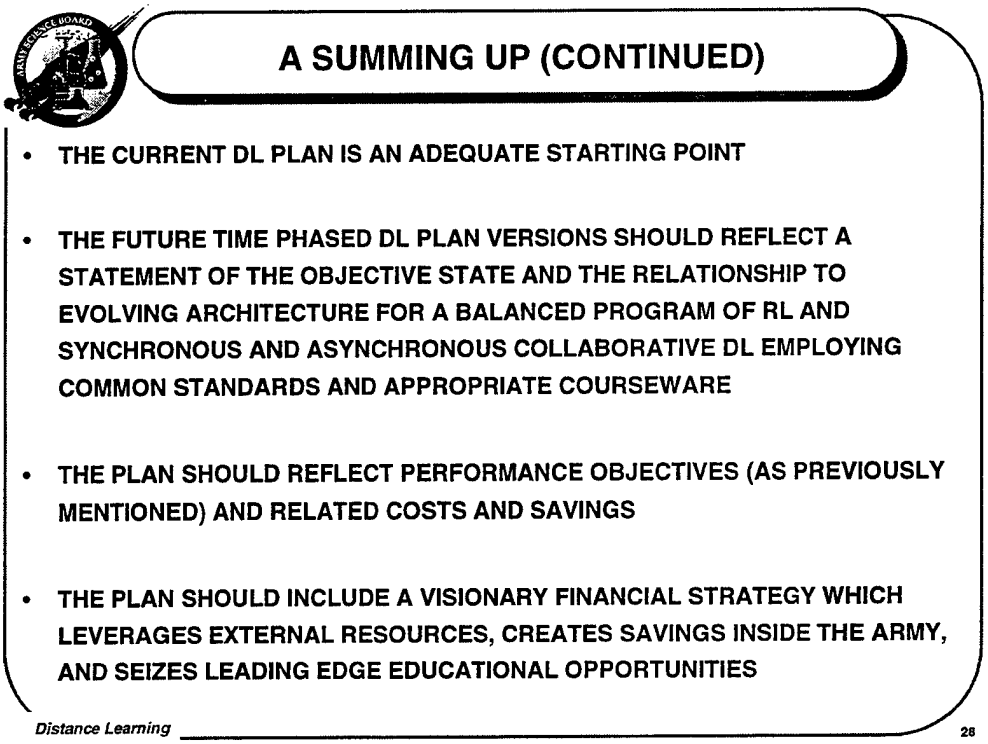
As with computers, telecommunications technology has been advancing exponentially in terms of network bandwidth. Industry and the military are building world-wide networks, with dense fiber networks available across the CONUS by the year 2000 and

world-wide high-speed networking available early next century. In the military, forces will be supported by a variety of global networks, including the MILSATCOM, the Tactical Internet, and wide-band global broadcast satellite capability. The commercial sector is also deploying worldwide high-speed networks, with over ten global commercial satellite systems currently under development. These include Iridium (Motorola), Teledesic (Gates-McCaw), Globalstar (Loral/Alcatel), and others. In all cases in the commercial sector, the expectation is that global satellite communications costs will be competitive with decreasing costs in terrestrial fiber-optic service and pricing will be proportional to the amount of bandwidth utilized. Given these trends, it is clear that the availability of high-speed, worldwide, wide-band telecommunications will not be a limiting factor in the implementation of any DL plan.

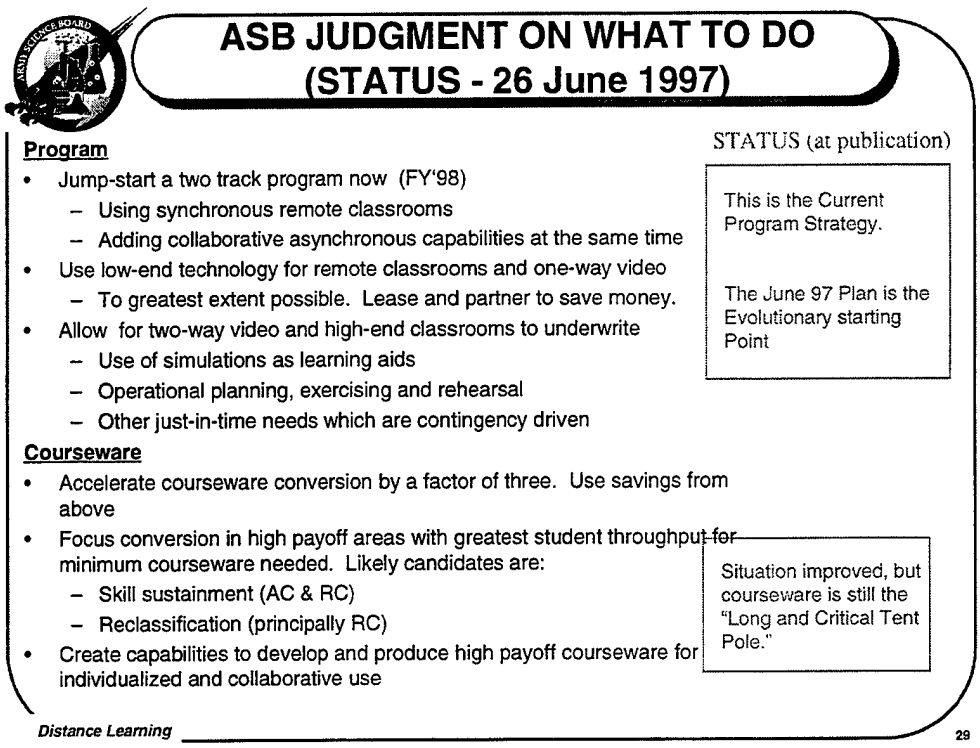


A Summing Up

Distance Leaning will fulfill the Army's need. A robust DL capability will provide great benefits for the Army regarding unit readiness and Soldier education as well as save time and money. Both the ADLP and the National Guard program designs focus on a synchronous remote DL plan based on an RL intellectual framework. Upgrading the ADLP from its inception until now has not changed the basic tenets of the plan. The base concepts of the ADLP were experimentally validated six to eight years ago. Reviewing the changes in DL technology over the same period, the Panel found major happenings in information technology. During this period, there was an explosive growth of the Internet. Additionally, the rapid expansion of fiber optic cable resulted in cable available to every high school and college in many states. The formation and operation of on-line university courses and the creation of an educational technology industrial base was evolving. Asynchronous DL-collaborative programs have emerged in the last five years. The Panel also discovered many programs for teachers to learn how to enhance education by utilizing DL facilities. During this same period, the Army lost most of its training developer personnel.



The Panel realizes the CW development challenges were addressed when TRADOC recognized the consequences of not satisfying the demands and orchestrated a community-wide effort to set priorities. As this Panel's report was briefed in June of 1997, 525 out of 2500 courses have been identified as targets for modernization for DL delivery. ADLP and TATS-C are addressing CW unification and overall DL priorities. CW development is judged to be the most important issue facing the Total Force. Conversion is planned to take thirteen years. Accelerating CW development and fielding by a factor of 2 to 3 puts the entire program on a self-paying basis in three to five years, rather than the current plan of eleven to thirteen years.



The Panel's Judgment On What to Do

The Panel envisions a three-phased approach to DL modernization where the following occurs:

Jump-start a two-track program in FY '98 using synchronous remote classrooms and adding asynchronous collaborative capabilities as time & funding permit.
Use low-end technology for remote classrooms and one-way video to the greatest extent possible, while leasing and partnering to save money.

Allow for two-way video and high–end classrooms to underwrite the use of simulations as learning aids; for operations planning, exercising and rehearsal; and, other just–in–time contingency driven requirements.

Accelerate CW conversion by a factor of three. Use savings from per diem accounts where soldiers remained on station and completed courses. Focus conversion in high payoff areas with greatest student throughput for minimum CW needed. Likely candidates are skill sustainment training for AC and RC, and reclassification training primarily for the RC. Create capabilities to develop and produce high payoff CW for individualized and collaborative use.

The Panel's judgments are based on the fact comparable civilian training is the easiest to remote because only a few, if any, training aid devices are required. Thus the actual RL course may be offered by remote delivery with little investment. The other factor is that

sustainment and reclassification training have such a significant demand that a 30% reduction in RL course length would result in notable savings in travel, per diem, and readiness.

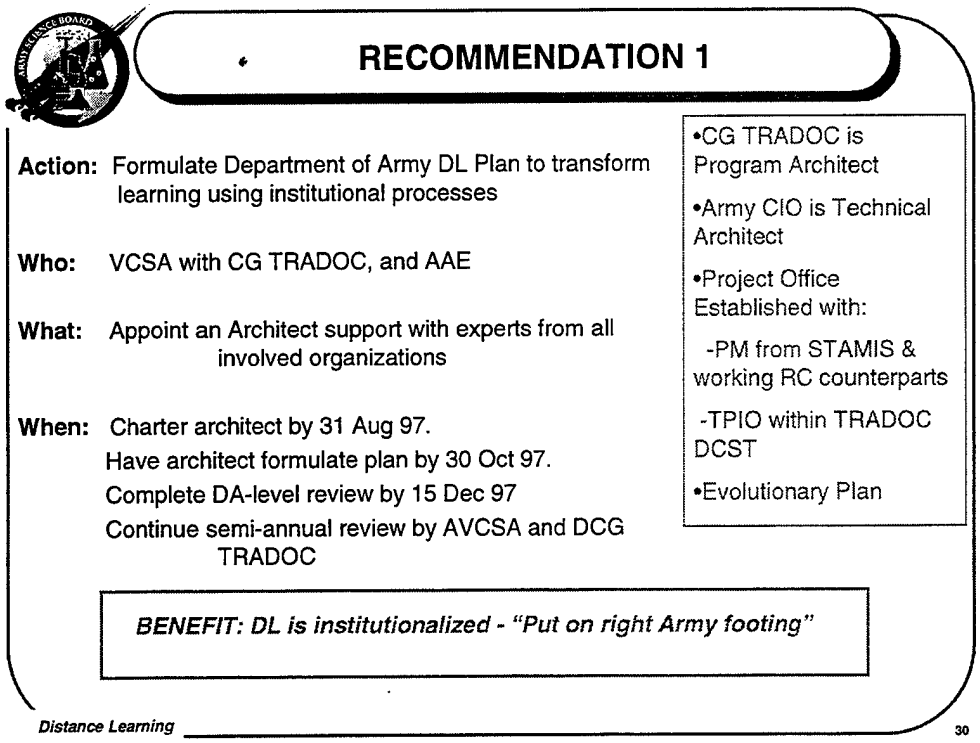
The Army should experience significant benefit through DL applications in skill sustainment for both the active and reserve components: MOSQ reclassification training, primarily for the reserve components, and just in time training needs of the total army. Samplings indicate student-teacher ratios could be raised from the Army's present fifteen to one to the industry model's fifty or one hundred to one. DL should also reduce monitoring requirements and result in dollar savings and Soldier MY returns from TTHS to unit mission requirements. Synchronous applications could be satisfied through low cost, low end, low bandwidth, one-way video classroom set-ups. Internet & Chat room type links for students should be aggressively pursued.

To maximize learning, minimize dollar and unit turbulence costs, and retain its leading edge, the DL program has to meet certain criteria. The program must be based on an intellectual framework that allows tradeoff decisions to maximize learning. This framework, discussed earlier, consists of students, whose prior knowledge, learning skills and motivation must be taken into account; learning objectives; and enablers (technology). Assessment of this framework will support practical decisions about which technologies, facilities and media will maximize learning and minimize cost.

Maximizing the cost-effectiveness of training over time cannot be achieved with marginal changes to the existing program. The program has to be completely re-engineered if it is to achieve the learning gains that research shows can be realized. Minimizing the unit turbulence attributable to RL, which will in turn minimize the investment and the recurrent costs, can do this. Re-engineering is a process, not a single event, and the program must be repositioned to handle technological obsolescence and seize emerging opportunities.

Finally, achieving program objectives must be accelerated to provide earlier savings.

TRADOC feels the Panel's recommended program is the current strategy under their June 97 ADLP update and their document is an evolutionary starting point. Additionally TRADOC feels the CW situation has improved, but agrees it is the critical issue to constantly monitor.



Recommendation 1

The use of the word 'architect' is deliberate. It calls attention to the Panel's belief a single person needs to be responsible for the manner in which the elements are arranged and organized.

Without the appointment by CG TRADOC, the AAE, and the VCS of a single architect, the Panel believes the time frame proposed above cannot be met.
Further, once the plan has been constructed, approved by the Army, and funded, the architect would step aside in favor of normal Army implementation.

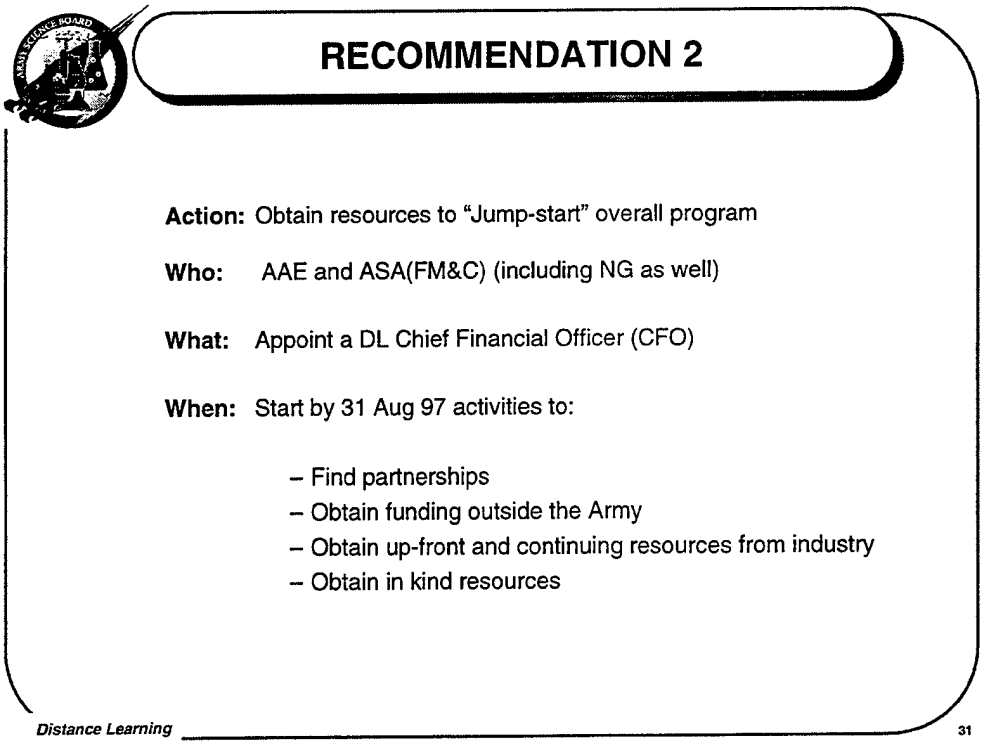
Since development of this report and the recommendations, DA & TRADOC have initiated the following actions:

CG TRADOC is the Program Architect.

The Army CIO is the Technical Architect.

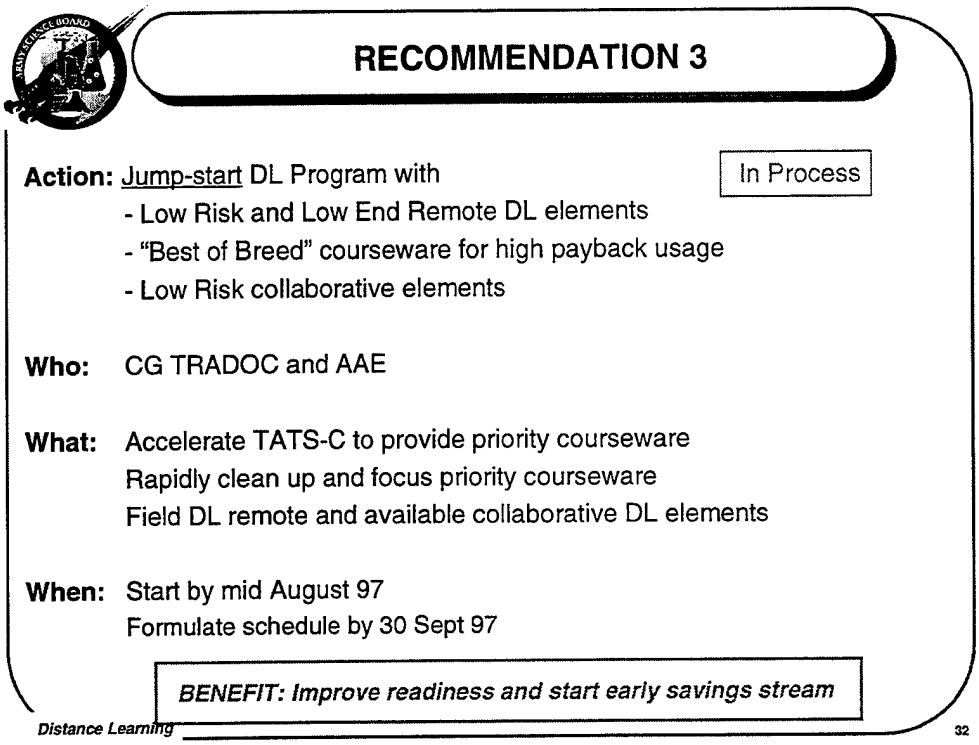
A Project Office has been established at TRADOC with the Program Manager (PM) from STAMIS and working RC counterparts. The TRADOC Program Integration Office (TPIO) is within the TRADOC DCST.

The Total Army Distance Learning Program (TADLP) Master Plan (MP) is the evolutionary document being updated by TRADOC.



Recommendation 2

The Panel's second recommendation is to suggest the appointment of a DL Chief Financial Officer (CFO). Although an unusual position for the Army, the function of the CFO would be to establish partnerships, both financial and in-kind, with other non-Army agencies (e.g., DARPA or Department of Education) in order to create a financial win-win situation. The Panel expects that although the program will pay for itself, particularly in the low risk synchronous mode, there will be a need for additional resources to "Jumpstart" the overall program and minimize the unknown risks of asynchronous modes. Thus this position will support the timely execution of the program. The recommended action officer is the Army Acquisition Executive (AAE) supported by Assistant Secretary of the Army, Financial Management and Comptroller (ASA FM&C).



Recommendation 3

The Army faces a major task in implementing the ADLP. As identified in previous recommendations, the transition to DL will engender major changes in the manner in which the Army's education process functions. Despite these uncertain conditions, the major cost savings produced by DL argue for an aggressive approach to the implementation of the DL environment.

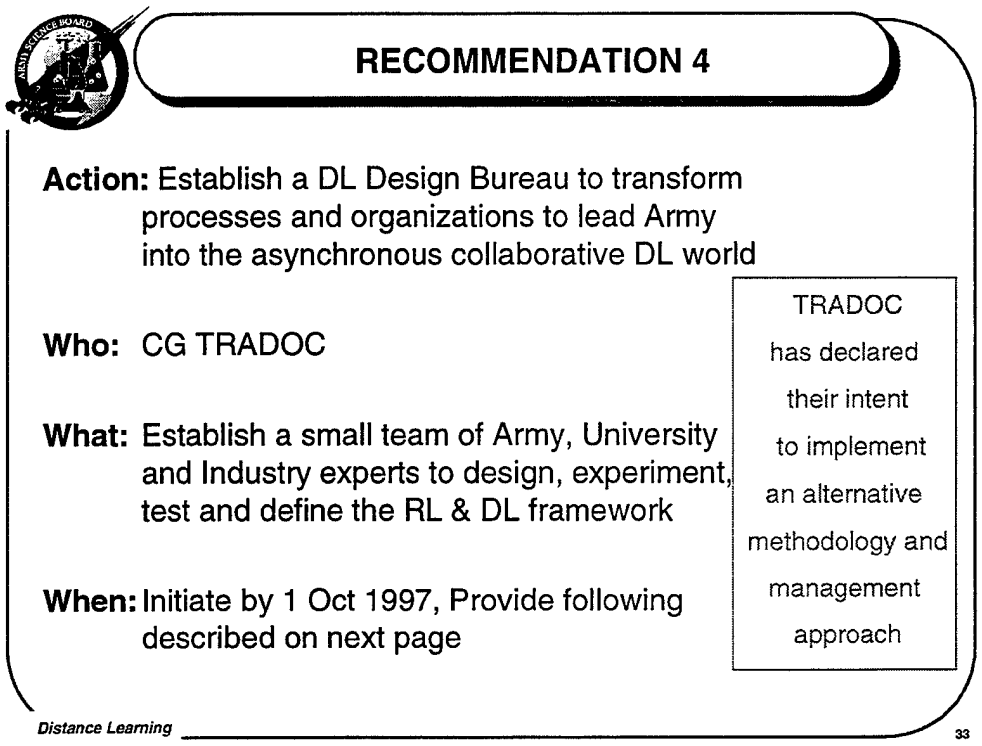
The Panel has examined the proposed plan for CW conversion and believes the process can be accelerated substantially. By emulating the Jumpstart processes developed for rapid software development, and by selecting the best available CW, the Army can significantly reduce the time and level of effort required to field an initial DL capability. The dynamics of DL technology and the rapid progress being made in the "art" of DL argue for a modest initial capability, fully recognizing future courses and technology may bear little resemblance to the initial capability. The critical factor is early implementation to produce rapid cost savings to be invested in future DL, apportioned as required.

The CG TRADOC should accelerate the TATS-C process to support rapid conversion to DL. CG TRADOC and the AAE must reduce the major investment being made in hardware, which will be obsolete within a matter of years. It is critical the selected enablers minimize the initial investment and yet will not introduce a major expense in the out years as the equipment reaches the end of its service life.

The importance of this activity argues for an early start in the planning process and the need for a schedule of execution by the start of the Fiscal Year.

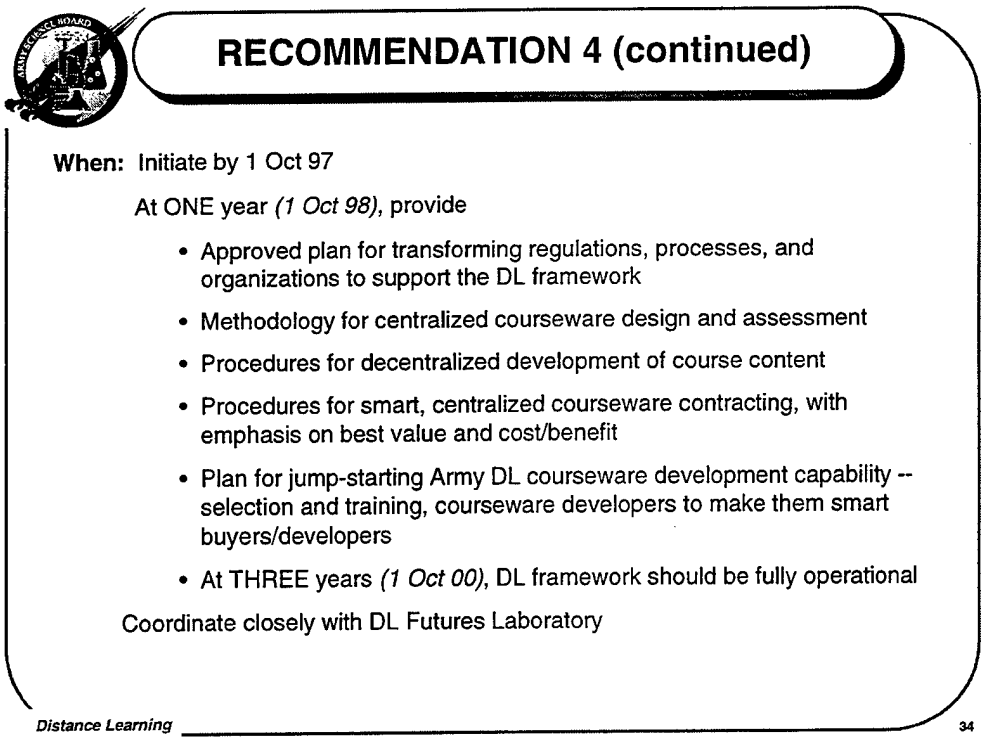
Smart, aggressive execution of the CW conversion coupled with a reasoned hardware investment can reap rapidly improved readiness and achieve substantial savings.

TRADOC feels this recommendation is in process.



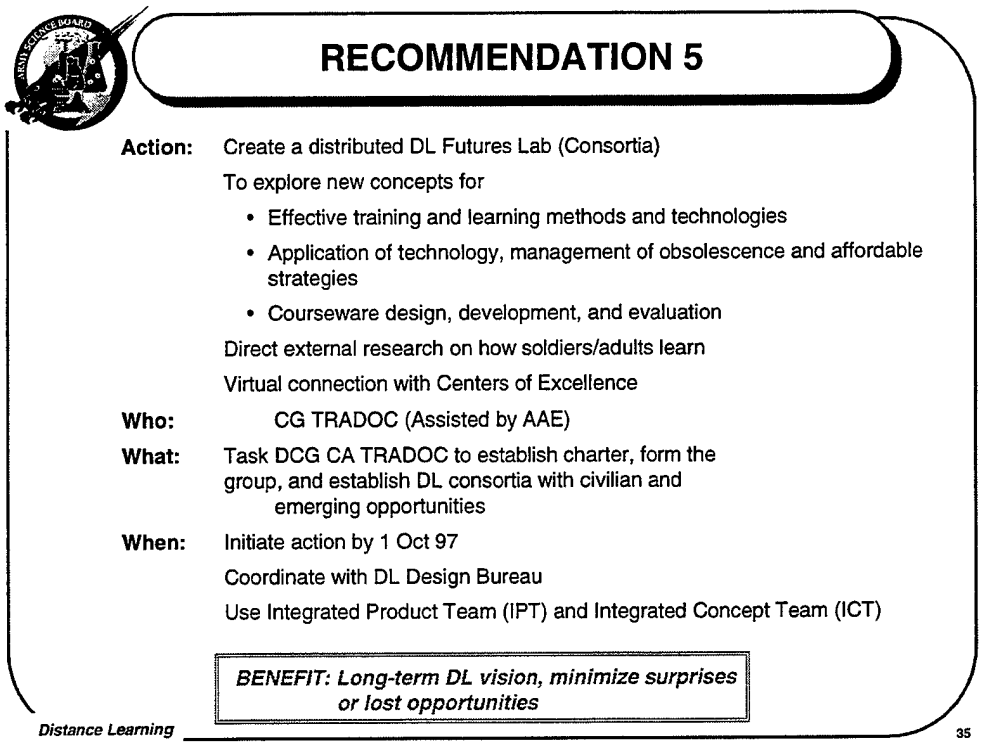
Recommendation 4

The purpose of this recommendation is to create a DL Design Bureau with the mission to provide command emphasis for the DL transformation and provide the processes and sources of expertise for developing standards, for example CW, for the asynchronous DL environment. It is recommended the CG TRADOC establish a team of experts from the Army, universities, and industry who will facilitate the design and assessment for re-engineering the DL education process.



The Panel recommends the Design Bureau be set up by 1 Oct 97. Sample activities would be to create a methodology for centralized design of CW and decentralized development. It is expected the vast majority of CW will be contracted out. Another example of processes needing change is the selection of training for training-developers to make them smart buyers/developers. The Bureau should coordinate closely with the organization discussed in the next recommendation (The DL Futures Laboratory) to facilitate the implementation of ideas identified by the Laboratory.

TRADOC has declared their intent to implement an alternative methodology and management approach.



Recommendation 5

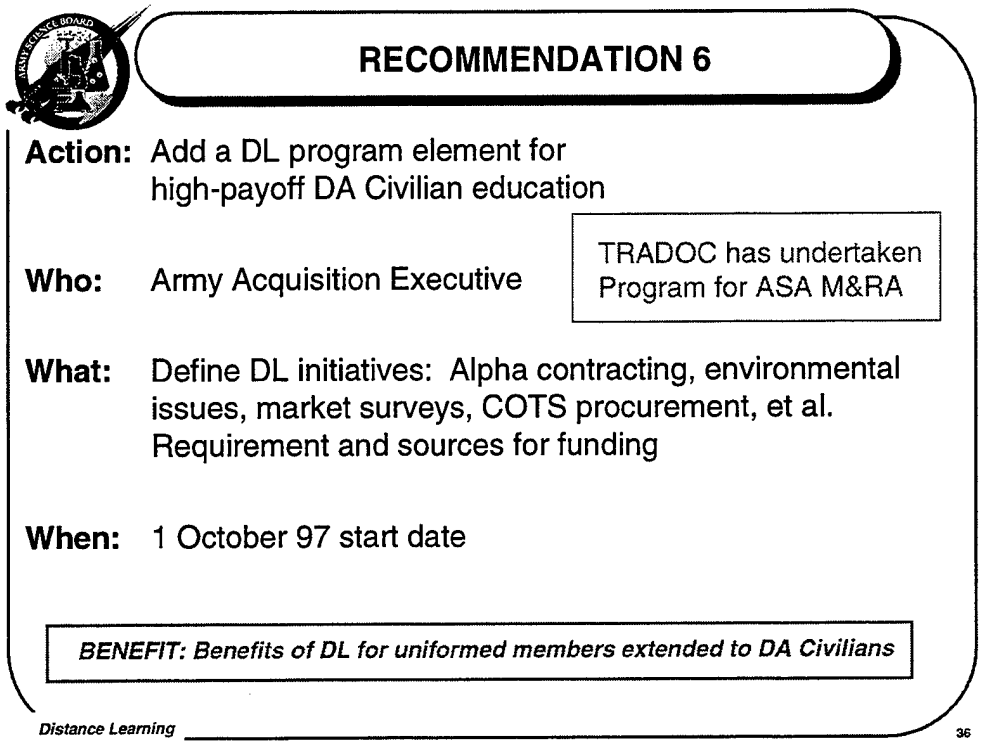
The rapid evolution of the entire field of DL, both how a student learns and the technology to support DL, demands a process whereby the Army monitors and exploits these capabilities. The Panel recommends the establishment of an Army led consortium to harvest the beneficial elements from this field. This consortium should be viewed as a laboratory with distributed networked members. Since much of the progress is being made within the academic community, it is critical the laboratory incorporates leading universities as well as commercial training organizations as represented by the global activities of the automotive manufacturers.

The lab would be expected to explore training and learning methods as well as their supporting technologies. Given the rapid rate of change in the technology area, methods of reducing the burden of obsolescence should be a matter of priority. The techniques and perhaps technology to support the design and development of CW can pay big dividends by providing an economical means of producing and updating future training needs.

The Panel suggests the laboratory be a TRADOC activity with strong support from the AAE. It is critical those elements of the acquisition community who produce "new equipment training" be a party to this process. This combined Army, Civilian, university and commercial venture, operating under the leadership of the DCG CA TRADOC, can and should lead the way in the smart efficient application of new technology to the Army's continuing CW load.

The Panel suggests the lab be initiated by 1 Oct 97, with the expectation it might be producing useful insights by early 98. The operation of this group should lean heavily on the lessons learned from the operation of both ICT and IPT's. This team approach to problem solving has proven itself to be a powerful tool in focusing on the high payoff strategies in system development. It can be applied with similar effect to the training problem.

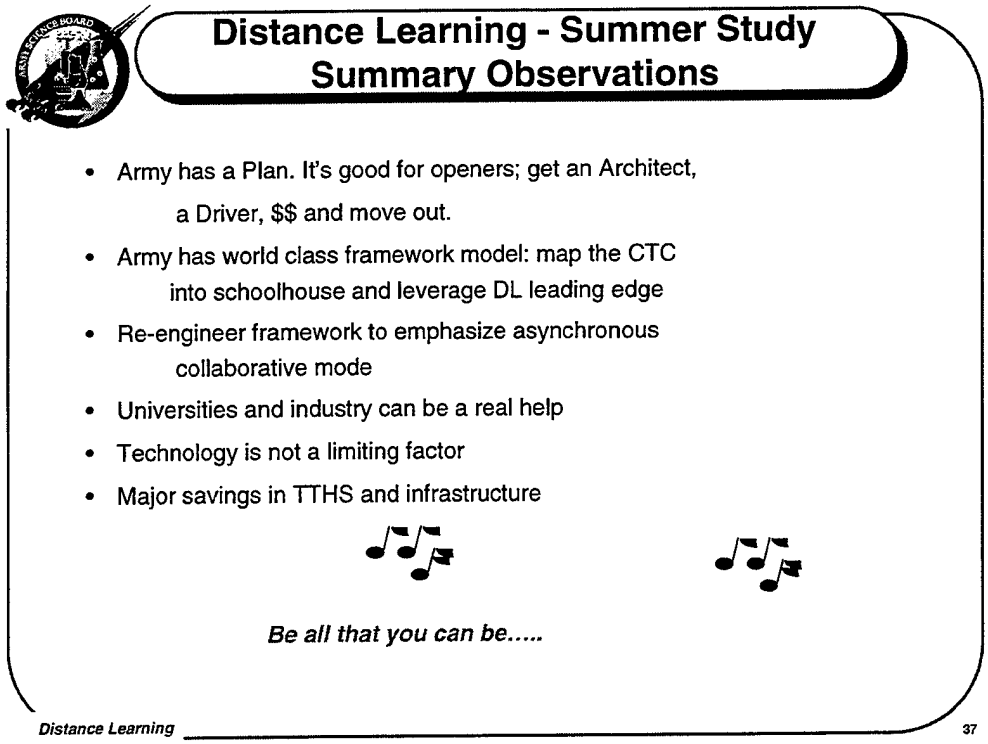
The mission of this group must be to ensure the training community does not meet with unpleasant surprises and effective opportunities are not missed.



Recommendation 6

The Panel's final recommendation is to add a program element for DL to train/educate Department of Army civilians. The current Army DL program's main focus is on service members. The benefit of DL (e.g., improve performance, decrease training time) for uniformed members would be extended to DA civilians. Suggested DL initiatives might involve alpha contracting or environmental issues. The suggested action agency is the Army Acquisition Executive (AAE).

TRADOC has undertaken a program for civilian DL with the Assistant Secretary of the Army, Manpower and Reserve Affairs (ASA M&RA).



Distance Learning – Summer Study Summary Observations

The ADLP is not only a start but also the lead document in the entire DOD. The Army should appoint the architect, put a clear vision in place with the future lab, design bureau and CFO, to drive the program; then aggressively seek out funding sources other than the Army. "Accelerate Distance Learning"!! Use the Army's CTC framework to incorporate industry and academe DL leading technologies to leverage the very best available innovations. Asynchronous applications will require a major re-engineering effort, and the emphasis should produce acceptable levels of DL collaborative environments. Partner, collaborate, and form consortiums to take maximum advantage of developments from Universities and industry (Ford & One Touch). The Army should move to realize major savings in TTHS and infrastructure through a dedicated, more centralized effort in CW development.

A world class DL education capability is crucial for today's Army. The Army must set world class objectives for both readiness and unsurpassed DL educational enhancements; objectives exceeding those of industry & academe. Program objectives of readiness, reduced turbulence, improved standards, cost avoidance and man-years returned to units are all achievable. The TADL MP must evolve to phased versions with a clear objective state, relationship to evolving architecture, balanced RL, synchronous and asynchronous DL-Collaborative employing common standards and CW. The plan with stated performance objectives and related costs and savings should include a visionary financial strategy.

APPENDIX A

TERMS OF REFERENCE

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
RESEARCH DEVELOPMENT AND ACQUISITION
103 ARMY PENTAGON
WASHINGTON DC 20310-0103

REPLY TO
ATTENTION OF

7 MAR 1997

Dr. Michael S. Frankel
Chair, Army Science Board
Research, Development and Acquisition
103 Army Pentagon
Washington, DC 20310-0103

Dear Dr. Frankel:

I request that you conduct an Army Science Board (ASB) Summer Study on "Distance Learning." The assessment should address, as a minimum, the Terms of Reference (TOR) described below. The ASB members appointed should consider the TOR only as guidelines and may include in their discussions related issues deemed important or suggested by the sponsor. Modifications to the TOR must be coordinated with the ASB Office.

Background.

a. The Army faces a massive and unique set of education and training challenges. The Army is geographically dispersed with units at well over a thousand locations. Personnel turnover rates can reach as high as 20 to 40 percent for given military occupational specialties. New equipment, doctrine and techniques are continually infused to upgrade and enhance unit capabilities in order to support the wide range of missions the Army must be able to accomplish. These factors taken together mean that education and training is a pervasive, continual process which consumes a huge amount of resources.

b. It is difficult, if not impossible, to find an analogous set of circumstances elsewhere in government, industry or academia that rival the challenges the Army confronts in meeting educational and training requirements and demands.

c. Traditionally, Army education and training has been characterized by the use of fixed facilities and movable populations of Soldiers. The Army along with other world class organizations are "learning" as well as "doing" organizations. Learning is part of continuous improvement and maintenance of competitive skills. The classic schoolhouse delivery solutions are no longer appropriate except in special situations.

d. At the same time, the Army has been in the forefront of advancing new concepts and adapting new technologies for educating and training its Soldiers. It is the DOD lead Service for advanced distributed simulation which could be

considered as training counterpart of distance learning. It has pioneered interactive and embedded training in the same integrated manner.

e. The Army and DOD are making substantial investments in distance learning. The Army plans to execute a significant distance learning program, estimated to cost about one billion dollars over the POM. At the same time, industries and academic institutions are addressing some of their needs with distance learning methods and tools.

f. To date, virtually all the hardware and network services (local and long distance) have been met using the technologies of the ongoing information revolution. Important software applications and innovations derive from this revolution.

g. However, course content which has data base and other software components requires its own research and development, Verification, Validation & Analysis and fielding. In addition, the circumstances of distance learning require robust methodologies for instruction, interaction and evaluation. Even with this, the opportunity exists for major advances which leverage the benefits flowing from the people and the developments which are driving the ongoing information revolution.

Terms of Reference.

a. Review the Army Distance Learning Plan. Comment and make recommendation on priority items to augment the current program.

b. Recommend training development and delivery in the post -2010 era commonly referred to as "Army After Next". Comment on the concept of "Soldier Driven" training as the basis for training management in AAN. Discuss its desirability and feasibility. Comment on the forms it might take, and what will be required of soldiers and their leaders within this context.

c. Survey business, industry, academia and government for innovative training and education initiatives. Ascertain associated technological, pedagogical, psychological or other interdisciplinary approaches aimed at imparting skills, knowledge and ability in new and effective ways.

Study Support. Co-Sponsors of this study will be Ms. Helen T. McCoy Assistant Secretary of the Army (Financial Management and Comptroller); LTG

Leonard D. Holder, Deputy Commanding General for Combined Arms, TRADOC; MG J.M. Riggs, Assistant Deputy Chief of Staff for Operations, and Ms. Sara Lister, Assistant Secretary of the Army (Manpower and Reserve Affairs). The Primary Staff Assistant is COL Francis Coppola, Assistant Chief of Staff USAR Combined Arms Center. Secondary Staff Assistant is Ms. Paula Rebar (ASA(FM&C)).

Schedule. The study panel will initiate the study immediately and conclude its effort at the eleven-day report writing session on June 16-26, 1997 at the Beckman Center in Irvine, California. As a first step, the Study Chair should prepare a Study Plan for presentation to the Sponsor that outlines the study approach and study schedule.

Special Provisions. It is not anticipated that this inquiry will go into any "particular matters" within the meaning of Section 208, Title 18 of the United States Code.

Sincerely,

Gilbert F. Decker
Assistant Secretary of the Army
(Research, Development and Acquisition)

APPENDIX B

PARTICIPANT LIST

PARTICIPANTS LIST

ARMY SCIENCE BOARD'S
SUMMER STUDY ON
"DISTANCE LEARNING"

Co-Chairs

Dr. J.V. Braddock
Founder
BDM International, Inc.

LTG (USA, Ret.) W. Shoffner

ASB Panel Members

Dr. Sue E. Berryman
Senior Education Specialist
The World Bank

Dr. Philip C. Dickinson
Consultant

Dr. Edward T. Gerry
Executive Vice President and CTO
Schafer Corporation

Dr. Richard L. Hartman
President
Advanced Optical Systems, Inc.

Dr. Walter B. Laberge
Associate Director
Institute for Advanced Technology
The University of Texas at Austin

Dr. Peter Lee
Associate Professor of
Computer Science
Carnegie Mellon University

Dr. Sung M. Lee
Vice Provost for Research and
Dean of the Graduate School
Michigan Technological University

Ms. Susan G. Lowenstam
Attorney

Dr. L. Warren Morrison
Visiting Scientist
Software Engineering Institute
Carnegie Mellon University

Dr. Harry F. O'Neil, Jr.
Professor of Education
Psychology and Technology
School of Education
University of Southern California

Dr. Karen D. Pettigrew
Research Mathematical Statistician
National Institute of Mental Health
National Institute of Health

Dr. Wilson K. Talley
President
Fannie and John Hertz Foundation

Dr. Harry L. Tredennick
Consultant

LTG (Ret.) Ronald L. Watts
President
Leadership Development Services

Staff Assistant

COL Francis Coppola
Assistant Chief of Staff
USAR Combined Arms Center

Sponsors

LTG Leonard D. Holder, Jr.
Deputy Commanding General for Combined Arms
TRADOC

Helen T. McCoy
Assistant Secretary of the Army
(Financial Management and Comptroller)

LTG John E. Miller
Deputy Commanding General
TRADOC

Gov't Advisor

MG Johnny M. Riggs
Assistant Deputy Chief of Staff
DCSOPS

Cognizant Deputy

Herbert K. Fallin, Jr.
Director for Assessment & Evaluation
SARDA

APPENDIX C

ACRONYMS

ACRONYM LIST

AAE	Army Acquisition Executive
AAN	Army After Next
AAR	After Action Review/Report
ABCS	Army Battle Command System
AC	Active Component
ADLP	Army Distance Learning Plan
ADTDL	Army Doctrine and Training Digital Library
AIT	Advanced Individual Training
ALSP	Aggregate Level Simulations Protocol
ASA	Assistant Secretary of the Army
ASB	Army Science Board
AST&D	American Society for Training & Development
ATRRS	Army Training Resource Requirements System
AVCSA	Assistant Vice Chief of Staff of the Army
BCT	Basic Combat Training
CAC	Combined Arms Center
CACNET	Combined Arms Center Network
CALL	Center for Army Lessons Learned
CAN	Campus Area Network
CAS3	Combined Arms and Services Staff School
CBI	Computer Based Instruction
CD	Compact Disk
CD-ROM	Compact Disk – Read Only Memory
CFO	Chief Financial Officer
CG	Commanding General
CG TRADOC	Commanding General TRADOC
CGSC	Command and General Staff College
CGSOC	Command and General Staff Officer Course
CMU	Carnegie Mellon University
CONUS	Continental United States
COTS	Commercial off-the-shelf
CSU-H	California State University-Hayward
CTC	Combat Training Center
CVW	Collaborative Virtual World
CW	Courseware
DA	Department of the Army
DA-DCSOPS	Department of the Army Deputy Chief of Staff, Operations
DA-level review NLT	Department of the Army-level review no later than

DCG CA TRADOC	Deputy Commanding General Combined Arms, Training & Doctrine Command
DCG TRADOC	Deputy Commanding General, Training & Doctrine Command
DISC4	Director of Information Systems for Command, Control, Communications & Computers
DL	Distance Learning
DoD	Department of Defense
FMC	Financial Management & Comptroller
Force XXI	Force 21
FORSCOM	Forces Command
GOSC	General Officer Steering Committee
GSU DLPS	Georgia State University Distance Learning Programs and Services
HQS	Headquarters
ICT	Integrated Concept Team
IEEE	Institute of Electrical and Electronics Engineers
ILE	Installation, Logistics, Environment
IPT	Integrated Product Team
IRR	Individual Ready Reserve
ITS	Intelligent Tutoring System
JIT	Just-in-time
KU	Kansas University
LAN	Local Area Network
LM	Lockheed-Martin
MILSATCOM	Military Satellite Communications System
MOSQ	Military Occupational Specialty Qualification
MRA	Manpower and Reserve Affairs
MSD	Managing Software Development
MY	Man-Year
NASA	National Aeronautics & Space Administration
NG	National Guard
NG PGM	National Guard Program Manager
NGB	National Guard Bureau
NSC	National Simulation Center
NTU	National Technological University
O&M	Organization & Maintenance

OA	Organization Assessment
OC	Observer Controller
OCAR	Office of the Chief of Army Reserves
OCONUS	Outside of Continental United States
OPFOR	Opposing Force
OSU	Ohio State University
PC	Personal Computer
PCC	Pre-Command Course
PCS	Permanent Change of Station
PEO	Program Executive Officer
PEO RCAS	Program Executive Officer Reserve Component Automation System
PEO STAMIS	Program Executive Officer Standard Army Management Information System
Quarterly IPR	Quarterly In Progress Review
R&D	Research and Development
RAM	Random Access Memory
RBOC	Regional Bell Operating Centers
RC	Reserve Component
RDA	Research Development & Acquisition
RL	Residential Learning
ROM	Read-Only Memory
SAT	Systems Approach to Training
SATCOM	Satellite Communications
SATS	Standard Army Training System
SEI	Software Engineering Institute
SIMNET	Simulations Network
SME	Subject Matter Expert
ST	Site Contractor
TADLP	Total Army Distance Learning Program
TASS	Total Army School System
TATS-C	Total Army Training System – Courseware
TDY	Temporary Duty
TNET	Teletraining Network
TOR	Terms of Reference
TRADOC	Training and Doctrine Command
TSP	Training Support Packages
TTHS	Trainees, Transients, Holdees and Students
UAH	University of Alabama, Huntsville

UMASS	University of Massachusetts
UNL	University of Nebraska, Lincoln
USAR	United States Army Reserve
USDLA	United States Distance Learning Association
VCSA	Vice Chief of Staff of the Army
VTC	Video Teleconference
VTT	Video TeleTraining
WAN	Wide Area Network

APPENDIX D

DISTANCE LEARNING IN INDUSTRY, ACADEMIA AND GOVERNMENT

SAMPLING OVERVIEW

The following brief overview and accompanying table represent the compendium of information collected from the various sampling visits, meetings, telephone calls, and internet searches conducted by the Panel Members. This overview highlights the key points in the three environments (Industry, Academia, Government) explored.

Industry

-Similarity of challenge and operational situation with Army
After preliminary education necessary for entry level position, both require continuing education with minimal interruption of ongoing operations

- Industry has used distance learning:
To achieve necessary education at minimum cost and loss of operational efficiency
effectively in augmenting skills and saving travel time and costs

- Industry, largely classroom based, is tending to move from a small number of people trained through simultaneous remote classroom education to reliance on training using the internet for JIT information

- Industry uses wide-bandwidth DL when incident to already existing administrative data channels

Academia

- Undergraduate degrees from established universities predominantly granted via residential training

- Virtual universities also granting nonresidential undergraduate degrees
Advanced degree education increasingly nonresidential

- User needs have driven universities to provide nonresidential learning

- Non residential education found to be equal to residential

- Studies show that DL fosters greater student interaction; Greater student interaction improves education

- Decreased emphasis on multi-media techniques occurring:
Lower band-width asynchronous techniques foster greater student interaction
A large amount of material is readily available on Internet

Government

- The DoD has been studying DL on an on-going basis; It has been slow to implement DL because savings are difficult to quantify

- The most innovative examples to date have been in the National Guard and Reserves

- DL is often tied in with state initiatives

- Currently available courseware is used without the long delays inherent in courseware conversion

- DoD dependent school system has also been a pioneer in DL

INSTITUTE FOR DEFENSE ANALYSIS

Example-Studies

- Sample - Institute for Defense Analyses (IDA). IDA is a Federally Funded Research and Development Center that has a primary function of conducting studies and analyses for the Office of the Secretary of Defense. One of its areas of interest is the cost and effectiveness of DoD education and training. The IDA has written well-researched reports concerning computer-based instruction courseware and DL. Its reports also survey industrial and university applications. IDA Paper P - 2567 Interactive Courseware (ICW) and the Cost of Individual Training, November 1992. Training Challenges - Many commentators have discussed current trends that increase the challenges to successful conduct of military training. It is unlikely that conventional approaches using platform lecture, paper-based workbook exercises and laboratory experience with actual scarce and expensive equipment will meet the demands for the training efficiency and effectiveness that are necessary for the coming century. Increasingly, trainers in both military and civilian settings are turning to technology as a source of improved training effectiveness and efficiency.
- Technology Costs and Effectiveness – Technology can be used to teach. It improves instructional effectiveness and reduces time to reach instructional objectives. Students enjoy using technology. Technology also lowers instructional costs and increases readiness. This sampling of results is neither comprehensive nor conclusive, but it strongly suggests that applications of technology in military training may be more effective and less costly than current practices. Therefore, it is reasonable to argue that the resources needed for initial investment in these approaches may be well spent. These resources will include funding, time, and effort to affect significant changes in professional practice and instructional institutions. .
- Budgetary Considerations – Traditionally, budget decisions have tended to focus almost exclusively on the potential for savings within the operations and maintenance (O&M) accounts. There are O&M savings to be gained from investments in converting from current training approaches to those that are technology based, but there are significant additional payoffs to consider as well. These accrue from the reductions in student time needed to train when technology is used and the concomitant increase in time these individuals are available for duty. One difficulty is that although the investment needed to convert training programs will most probably come from O&M accounts, major savings will appear in personnel accounts, not in O&M. It is necessary to quantify the potential payoff in terms of student pay as well as the O&M savings generated from investments in training technology.

Contact information: Dr. Dexter Fletcher 703-578-2837 "fletcher@ida.org"

CALIFORNIA STATE UNIVERSITY, HAYWARD (CSU-H)

Example-Networked Students and Instructors

- Sample – CSU-H "The transmission medium isn't as important as the amount of preparation of the material to be taught." Dr. Roger Parker, Director, Instructional Media Center/Distance Learning, CSU-Hayward

- Observations - The 22 campuses of CSU are interconnected with a variety of point-to-point-microwave, ISDN, fiber optic cable, coax, and standard telephone lines. CSU is now exploring C and Ku band satellites using 3 meter and 3.7 meter dishes.

  The following definitions were used: Synchronous learning requires the teacher and the student(s) to be somewhere at a certain time. The teacher and the class may be physically remote, but the two are simultaneously in communication.

  Asynchronous learning allows the student to choose the speed, time and/or place of instruction.

  DL has been in existence since the first correspondence course, which is a good example of asynchronous learning. Contrast this with the idea that a school consists of a "log" with a teacher sitting on one end and a student on the other- synchronous learning. The CSU System is using DL for teaching both cognitive and motor skills. CSU has participated in various studies to see how DL compares with traditional and other learning modes. The result is that the transmission medium is not as important as the amount of preparation of the material taught. A course that must stand completely alone, asynchronous, takes an incredible amount of work to prepare. It is only practical for organizations, such as General Motors and the Army, which have to teach the same material repeatedly to very large numbers of individuals.

Contact information: Dr. Roger Parker, Director, Instructional Media Center/Distance Learning 510-885-3692 510-885-3953 (Fax) **rparker@csuhayward.edu**

CMU INTELLIGENT TUTORING PROJECT

Example – Networked Classrooms

- Sample - CMU Intelligent Tutoring Project
- Purpose: Apply cognitive psychology and established teaching principles in design of artificially intelligent tutoring systems.
- Infrastructure: Practical Algebra Tutor ("PAT") is in use in four high schools nationally. Classrooms equipped with network of workstations, along with teacher.
- Observations: The CMU Intelligent Tutoring Project is a research project investigating the use of artificial intelligence techniques in a computer-based tutoring system. The project members include cognitive psychologists and computer scientists working together to apply established teaching principles in the design of tutoring systems. The main demonstration system produced by the project is the Practical Algebra tutor, which teaches high-school algebra. Currently deployed in four high schools, PAT has shown itself highly effective in teaching concepts in algebra. The main emphasis of the system is to stress cognitive development by forcing students to think abstractly. It does this by posing problems and then structuring the student's interaction with the problem so it can be viewed in several different ways, such as by equations, words, graphs, and pictures. The PAT makes extremely aggressive use of computer technology to maximize transfer of cognitive and conceptual skills. Performance of students in standardized tests shows clear superiority over traditional classroom learning. However, construction of course material is extremely difficult and relies on expert support. Currently, CMU IT is a research concept, not a product.

Contact Information: DR Ken Koedinger, Human-Computer Interaction Institute , Carnegie Mellon University, 412-268-7667 "koedinger@cmu.edu"

CMU JUST-IN-TIME LEARNING

Example – Non-Networked Students

- Sample - CMU Just-In-Time-Lectures (JITL)
- Purpose: Exploit computer technology, but with reduced delivery and productions costs.
- Infrastructure: PC/Mac and CD-ROM based. (Special "hyper-lecture" software for multimedia presentation of learning material)
- Metrics: Goal is less than 10 hours of production time per hour of DL product. (Simple, inexpensive, and widely available production equipment)
- Observations: Simple video, either non-networked via videotape or networked via VTC, has the advantage of being relatively inexpensive to produce and deliver. In addition, simple video is a delivery mode that is familiar to both teachers and students. However, video also has a number of limitations. Videotape is non-interactive and linear. This makes it hard for the teacher or student to ask questions, and little or no support for topic search is available. The CMU Just-In-Time-Learning (JITL) concept is to exploit computer technology to enhance video-based DL while retaining the advantages of relatively inexpensive production and simple delivery. A JITL comes on a CD-ROM and contains software that will run on any PC or Macintosh system. When played, the CD shows a video, usually containing a lecturer super-imposed on a second video track of synchronized multimedia material. The multimedia material can be simple PowerPoint presentation slides, computer-based graphics/animation, or video demonstration of a skill/concept. A second window shows a scrolling outline of the lecture. The student can click on this for options on replay, skipping forward or back, and searching for specific topics of interest. Finally, there are a number of buttons for assessment tests, asking and/or answering questions, and access to on-line supplementary materials.

Contact Information: DR Roger Dannenberg, Associate Professor, School of Computer Science, 412-268-3827 "roger.dannengerg@cs.cmu.edu"

CMU ON LINE

Example – Networked Students

- Sample - CMU Online
- Purpose: Provide self-paced and interactive learning for college students.
- Infrastructure: PC/Mac, Internet, and written materials.
  (Online material and assessment tests are tracked and generated uniquely for each student, according to his/her observed competence. Utilization: Over 300 students learning individually, for college credit.)
- Observations: The CMU Online system uses computer technology to tailor course content and assessment to individual student strengths and weaknesses. The course materials and assessment exercises are created and stored in a database system. The DL system is then made available through a World Wide Web interface (Netscape). The course topics are organized in a "non-linear" fashion that allows students to find specific topics of interest and choose the order of presentation. As students complete the course topics, the DL system generates tests and homework assignments automatically, taking into account the student's performance on previous tests and assignments. In many cases, the software system also does grading and feedback diagnosis automatically, though in some cases, a human instructor is required to do full assessment and grading. Performance on tests shows that the DL students do at least as well as RL students. No time pressures are placed on the DL students. This possibly accounts for the good performance; however, it also means that many students, about one-third, fail to complete the full course. Organization and creation of course content suitable for software-customized delivery and assessment is laborious.

Contact Information: DR Peter Lee, School of Computer Science, CMU, 412-268-6000, peter.lee@cs.cmu.edu

CMU SEI MANAGING SOFTWARE DEPARTMENT (MSD) COURSE

Example – Non-Networked Students

- Sample - SEI "Managing Software Development" (MSD) course.
- Purpose: Allow non-resident students to complete portion of MS requirement at SEI.
- Infrastructure: Small modules (2 weeks) with videotaped lectures. (Tutor-presented video.) Live chat sessions via Java-based system on WWW. Email with instructors.
- Observation: Carnegie Mellon's Software Engineering Institute (SEI) offers a Master of Software Engineering (MSE) degree. Some courses for the MSE are now offered via DL. Live lectures via VTC were previously used. Later, these were dropped in favor of videotape when it was learned that more than 80% of the recipients were doing their own videotaping anyway. Currently, a live tutor presents the videotapes. The tutor is able to stop the tape to ask/answer questions as well as replay segments as students request them. In order to ensure that each student has enough time pressure to complete the course, each module is kept short, roughly 2 weeks each. Each module is supported by written and WWW materials and is terminated with an assessment test as well as a live chat session on the WWW. The approach has proven to be cost-effective as well as effective in teaching. DL students perform at least as well as the RL students.

Contact Information: Dr. Jim Tomayko, Professor, CMU, MSE jet@cs.cmu.edu

UNIVERSITY OF ALABAMA, HUNTSVILLE (UAH)

Example-Networked Classrooms

- Sample: Georgia Tech, U. of Alabama in Huntsville, and NTU
- Observations: This information comes from research papers and an interview with the professor concerned. The UAH professor was invited to teach a graduate level NTU course in management. The nearest source location was Georgia Tech, a four-hour drive. The professor decided to try a somewhat controlled experiment in DL. The student body consisted of a live class at Georgia Tech and NTU students spread throughout the country who simultaneously viewed a video telecast. The NTU students had an audio link back. The professor taught the same class at UAH to a live class, on a different day of the week. The professor met twice with the NTU students at group meetings. All students took the same tests. All tests were scored in a blind manner so that the "scorer" did not know which class the student was taking. The NTU DL students scored significantly better than the live class students did. Analysis and observation provided the following insight. The NTU students were active employees, and each felt that completing NTU courses and a degree would enhance their career with their current company.

UAH participants were part-time students who mostly looked on the degree as a way to get a better job with a new employer. The Georgia Tech students were full-time students taking a course to fill requirements. The hypothesis is that NTU students were interested in knowledge, the UAH students in degrees, and the Georgia Tech students in credit hours. In the tests, the NTU students scored best on practical problem solving and in-group problems. The Georgia Tech students scored best on purely theoretical problems. The UAH students scored the worst on group collaboration. Both the Georgia Tech and UAH live classroom students, by questionnaire, had little interaction with each other outside the classroom or interaction with the professor. In contrast, the NTU students, who had to communicate via email, developed an intense interaction. Problems were solved jointly. In fact, collaboration went beyond the class. Students helped each other with company problems and developed business relations between their companies. The students also interacted much more intensively with the professor, sending in problem solutions one at a time and getting feedback before the next problem. Observation of the NTU classroom showed that the students were looking at the pre-delivered notes and a textbook while listening to the professor, rarely was the screen viewed. In contrast, the in-class students only looked at the professor and were much less actively involved. The professor concluded, in addition to these observations, that training the teacher is critical, and instructing this course took significantly more work than a conventional course because of the intensive student interaction.

GEORGIA STATE UNIVERSITY

Example-Networked Classrooms, Students and Instructors

- Sample: The Department of DL Programs and Services at Georgia State University
  - GSAMS - The Georgia Statewide Academic and Medical System (GSAMS) - videoconferencing network providing fully interactive, two-way DL environment.
  - Interactive Technology Project - State's proposal to improve existing distance learning environments, project status, pilot projects, etc.
  - Instructional Television Fixed Service - ITFS (Instructional Television Fixed Service) - channels providing educational/informational programming carried by a cable tv company. Educational programming from numerous sources to be delivered on ITFS full implementation, Fall 1998. GSU's Division of Distance Learning Programs and Services coordinates ITFS consortium programming schedule; system testing and phase-in of educational offerings, Fall 1997.
  - Special Programs – World Food Day Teleconference, the Picasso Program with the High Museum, etc.; **GSU DLPS Business Partnerships** – direct and indirect include: Bell South Cable, Apex Museum, High Museum, Zoo Atlanta, Fernbank, Adult Literacy Program, Georgia Tech, University of Georgia, Dekalb Community College, Georgia Public Television, Kennesaw State University, Michael J. Coles School of Business, ACTV, CNN, Division of Continuing Education at GSU, World Food Day, Gerontology Program (involves 8 Georgia universities)
    - TREES Program – A special technology utilization co-reform program with funding from the Coca-Cola Foundation called Developing Technology Rich Educational Environments. Program goals are enhancing educators ability to use technology in their work and collaborating technology use more effectively with Georgia's K-12 sector and the university system. Program initiated in 1995; tests indicate it is effective at introducing faculty at all levels to the technology use in education. Sessions in this program teach the educators on being DL instructors; the creation and use of multi-media, integrating multi-media into new and existing courses, integrating technology into the classroom and selecting and preparing their own CD educational products.
    - Gerontology Collaboration - Provides information on the Distance Learning partnership in gerontology through a description of the initiative, list of the institutes involved, and the purpose of the project.
- Observations: DL is rapidly maturing as a highly effective method to deliver education and information to a dispersed audience. The Georgia Department of Education has installed over 300 DL sites in the state, located in institutions of higher education, selected medical institutions, nearly all elementary schools, and most high schools. A major portion of these sites are part of the Georgia Statewide Academic and Medical System (GSAMS). These sites serve as the primary backbone of the state's delivery of DL via videoconferencing. Extensive Internet World-Wide-Web pages provide faculty, educators, support personnel, and students with guidelines for developing and delivering DL education and communication in a typical classroom setting. Particularly notable is the Distance Learning Handbook at http://www.gsu.edu/webprj01/adm/wwwdls/public_html/Presenters/NetIt24/7356x.htm

Contact information: : Georgia State University, Division of Distance Learning Programs and Services (DLPS) (404) 651-1778; Carla Relaford, DLPS Director, relaford@gsu.edu; GSU DL website: http://www.gsu.edu/~wwwdls/

KANSAS UNIVERSITY

Example-Networked Classrooms and Students

- Sample: Current DL applications at Kansas University (KU)
  - Continuing Education with VA
  - Offering DL course on how to develop DL courses
  - Experience with DL in Norway
  - Civil Engineering courses via DL

- Observations:
  - Asynchronous teaching to meet the needs of the students
    - Classes "broadcasts" three times a week
    - Students work at their convenience
    - Respond to homework via internet

  - Problem oriented study – building a bigger bridge challenges students
  - Follows model used by architecture program
  - Student collaboration via the Internet provides strong reinforcement of training; Students tend to solve problem among themselves
  - Those unanswered questions are structured and fed to instructor via Internet

Contact Information: Sandra W. Gautt (swg@co.wpo.ukans.edu)

LOCKHEED-MARTIN MISSILES & SPACE

Example-Networked Classroom

- Sample - Lockheed Missiles and Space, Sunnyvale, CA

- Observations: All computer operations of the firm are centralized. CBI is the normal mode for training and instruction within that group; the group is comprised of some five thousand people. Courses are taught in sixty to ninety minute sessions to four or five hundred people each week. Courses are offered not only in applications and language training, but also security, environmental training and health, and diversity training. The main reason for using CBI is savings, followed by uniformity of training. There appears to have been no analysis as to the use of CBI versus synchronous DL or traditional teaching methods. However, the trend at LM appears to be toward movement onto the Internet rather than diskettes, cassettes, or CD's. This is partly due to the need to adapt to regional variations.

Contact Information: Pat Anderson Executive VP, LM Enterprise Information Systems

NASA AMES RESEARCH CENTER

Example-Networked Classrooms & Students

- Sample - NASA AMES Research Center

- Observations: Web-based K-12+ multimedia DL through Virtual Conferencing (Lectures, participants, chat windows, video capability, 300 user maximum); university courses (lectures, slides, transcripts, live—virtual conferencing—or recorded); live on-line (Antarctica, Jupiter, shuttle, Hubble, Mars, Mount Wilson remote control). NASA Ames has set up a DL program to service local K-12 schools. Despite a heavy investment in equipment, the lack of resources allocated for the content of the lessons were apparent. There were also technical problems with the LAN that was used to demonstrate some of the classes. NASA might be expected to show live pictures from space to interest students, but the material which the Panel saw was Home Page-like with canned stills and video clips. The elements of a successful program are there, but not the program itself.

Contact Information: Mark Leon, NASA Ames, Moffett Field, CA

ONE TOUCH SYSTEMS

Example-Networked Classrooms

- Sample: One Touch Systems, San Jose, CA

- Observations: One Touch is in the satellite teaching business with high band transmission and low band response from the

students. By so doing, live classroom experience of satellite-based instruction can occur. In a synchronous mode, the instructor's image is beamed to one or more classrooms via satellite and down link. At points during the lecture, the instructor displays a question with multiple choice answers. Each student has a keypad that is signed on at the start of class using their name and ID. The student's individual answers are recorded by pressing a key on the pad. All responses are returned to the lecturer via land lines and are interpreted by the Site Controller (ST), a computer. After an appropriate time, the ST produces an analysis of the answers, which the instructor may share with all of the students. The instructor will be able to explain which answer was correct and which incorrect answer was most often chosen. The instructor may then call on individual students for comments; the ST has that data available. If the pace of instruction is too fast, the student may press a "panic" button. A screen presents the sum of all such inputs to the instructor, perhaps as a rising column of red. The teacher may simply slow down if it becomes clear that the pace is moving too quickly. The system is in use at Ford where twenty-three host sites with fifty to sixty hours per day on over 10 channels and up to 14,000 "classrooms" are used. There were 220,000 taught in 1997. Government agencies, such as FAA, are using the system, and elements within the DoD and the Army are buying into it.

Contact Information: Ken Chow, Director of Marketing, One Touch Systems, San Jose, CA

RAND CORPORATION

Example-Research & Development

- Sample: The RAND Corporation

- Observations: The RAND Corporation is a non-profit federally funded research and development corporation. It conducts military and non-military research and policy analysis. This R&D effort is performed for the U.S. Department of Defense and its service branches, non-defense agencies of federal and state governments, associations such as the California Education Roundtable, foundations, cities, and foreign clients, including the European Union. Its headquarters is in Santa Monica, California, and a branch office is located in Washington, D.C. and representation positioned in New York City and Delft, the Netherlands.

  Its Institute on Education and Training publishes on issues of DL, such as *The Intelligent Tutor for Basic Algebra, Overview of Object-Oriented Microworlds for Learning Mathematics, and Untangling the Web: Applications of the Internet and Other Information Technologies to Higher Education.*

Contact information: Dr. Roger Benjamin, Director, Institute on Education and Training, The RAND Corporation, 1700 Main St., Santa Monica, CA. 90407-2138; (310) 393041 1, Ext. 6745; Roger-Benjamin@RAND.org.

SUN MICRO SYSTEMS

Example-Networked Systems

- Sample: Sun Micro Systems, Palo Alto, CA

- Observations: Because Sun makes and sells workstations, its presentation was concerned with the use of a workstation in DL situations.

  Sun has established LANs with PCs that are able to download exceptional graphics from a Sun server.

  For such systems, network bandwidth appears to be the constraint. Within the LAN, there does not seem to be such a problem. For the Army, there are likely to be solutions to problems that will work with any given bandwidth. Some problems are likely to require more bandwidth than is currently available.

Contact Information: John Dutra, Director, Network Architecture; Anne Schowe, VP and GM, Interactive Services Group; David Bailard, Director, Government Marketing, Sun Micro Systems, Palo Alto, CA

CALIFORNIA VIRTUAL UNIVERSITY

Example-Virtual University

- Sample: CALIFORNIA VIRTUAL UNIVERSITY:
  "Intellectual property rights probably are a bigger problem than installation of even more physical equipment." Dr. James Burke

- Observations: Dr. Burke is a consultant to the California Virtual University initiative. It is California's response to the 13 State Western Virtual University. The CVU is minimally funded by the State of California. The players include (outside the Governor's Office) the University of California System, the California State University System, several private universities,

and some federal installations.

There has been little attention paid to the intellectual property rights inherent in a system that would allow a student in, say, Chico, to take graduate courses from teachers at Stanford, UC-Irvine, CSU-San Diego, and other places and get the graduate degree from the University of Southern California. A part of the problem is that TV teaching is well rewarded at Stanford and carries almost negative awards at UC campuses.

A minor problem is the physical equipment: it is believed that by the time the course content and ownership rights are worked out, the K-12 classrooms throughout the entire state will be available to serve as auxiliary classrooms for the CVU. Hence, no major investment in equipment and facilities will be needed if appropriate agreements are worked out.

Contact Information: Dr. James Burke, Consultant, Governor's Office on the CVU

UMASS DEPARTMENT OF COMPUTER SCIENCE

Example-Courseware Development

- Sample - University of Massachusetts, Department of Computer Science
  - Purpose—Focus on intelligent systems for learning, modeling, control issues and inference mechanisms for human-machine communications
  - Infrastructure—Center for Knowledge, Communication and Computer-based Instructional Technology
  - Metrics—Episodic memory in student modeling to evaluate student performance is being developed
  - Courseware development —MEDTECH Tudor Anatomy & Physiology
- Observations
  - Example of an applicable course taught self paced over an 18 month duration cut to 6 months
  - Training Development team composed of programmer, researcher & SME
  - Dual Use Approach for applications benefiting academia & military
  - Student modeling metrics development working at a baseline level with continued R&D for comprehensive progression

Contact Information: Beverly Woolf 413-545-4265 "bev@cs.umass.edu"

UNL DEPARTMENT OF DISTANCE EDUCATION

Example-Courseware Development

- Sample - University of Nebraska, Lincoln, Department of Distance Education
  - Purpose—Communications, Learning, and Assessment in a Student-centered System (CLASS) for electronic interaction among students, instructors and external resources
  - Infrastructure—22,000 students in more than 135 countries
  - Metrics—Course Map tool charts student's exploration of a variety of paths through material for learning activities and experiences
  - Courseware development —Global Perspectives: Bosnia, Environmental Chemistry, Writing and Informal Geometry
- Observations
  - CLASS courses provide the following benefits: for teachers to monitor students progress; for students to pace their individual progress; for courses to accommodate various learning styles; for instructors and students to access a broad array of resources; and for instructors to develop levels of skill and comfort with technology;
  - Course Production team & Curriculum Development Unit for course sustainment
  - Partnership between R&D, Telecommunications & Education Communities

Contact Information: Charlotte Hazzard 402-472-0884 "hazzard@unlinfo.unl.edu"

OHIO STATE UNIVERSITY

Example-Networked Classrooms

- Sample - Ohio State University
- Purposes
  - Enhanced learning environment for enrolled students
  - New Revenue Generator
    - Student and Corporate

- Outreach
  - Statewide to K-12
  - Closer relations with alumni
- How is it done?
  - CDs, Interactive video, Video delivered to desktop, Web
- Metrics?
  - No. Only rudimentary evaluation. Faculty committee with student representation
- Courseware
  - Some outsourcing
  - Mostly faculty member does content using a standardized set of templates
    - Shared staff to assist faculty
    - Student trainees also assist
    - Best practices server on web
- Other
  - Member of "Learn Share"
    - Consortium of 9 Fortune 500 Cos., 3 Universities and State of Ohio
    - Develop training materials and research pilots on effectiveness of different technology methods

Contact Information: Jim Davis, Associate Provost & Director of University Technical Services 614-292-6553 "jfdavis@osu.edu"

MITRE CORPORATION

Example-Courseware Development

- Sample – MITRE Corporation
  - Purpose—Intelligent Collaborative Learning Environments, Intelligent Tutoring Systems (ITS) and Computer-supported Collaborative Learning (CSCL) tools.
  - Infrastructure—R&D Efforts
  - Metrics—Learning Companion to stimulate effective coaching
  - Courseware development —Collaborative Virtual World (CVW)
- Observations
  - Enhancement of computer supported collaborative work environments to supply life-long learning and support for the work force for more efficient and effective workflow.
  - Simulated peer partners with the student to more clearly lay out reasoning so ITS will effectively address the student's needs through coaching, remedial help, and appropriate follow up exercises.
  - CVW software adds features lacking from commercial and academic products such as a room paradigm and object-oriented characters to occupy a room and provides its customers a broad array of collaborative technology to best fit their needs.

Contact Information: Bradley Goodman 617-271-2085 "bgoodman@mitre.org"

FT. KNOX ARMOR CENTER & SCHOOL

Example-Courseware Development

- Sample - Fort Knox Armor Center and School
  - Purpose—Task management process and development of automation supported course material. Armor Center multimedia distance learning initiatives
  - Infrastructure—CAN & link with Kentucky Teletraining Learning Network
  - Courseware development —Task Database and Standard Army Training System (SATS) Management
- Observations
  - Army wide system for automated training & doctrine development
  - Task reviews by Proponent Schools and utilization of Task Performance Support Codes
  - Shared dual use, internet utilization and access.

Contact Information: Mike Kelley 502-624-3346 "kelleym@ftknox-dtdd-emh5.army.mil"

COMBINED ARMS CENTER & FT LEAVENWORTH

Example-Networked Students & Instructors

- Sample - Combined Arms Center & Fort Leavenworth
  - Purpose—Officer/Leadership Training and Education of over 1,500 resident students (CGSOC, CAS3, PCC, & WARFIGHTER Exercises) and 8,000 plus non-resident students. WARRIOR (Institution) and WARFIGHTER (Unit) applications of Army Training XXI.
  - Infrastructure—WAN, CAN, CACNET and Internet Networks
  - Courseware development —TATS-C and DL initial stages of courseware redesign
- Observations
  - Army wide Research Library being established through Center for Army Lessons Learned (CALL)
  - Aggregate Level Simulations Protocol (ALSP) established in SIMNET possible application for Simulations experiences in DL
  - CAC Ft. Leavenworth CALL, CGSC and National Simulations (NSC) Technology Innovation opportunities offer DL applications in educational development.
  - TNET, VTT and PicTel video training connectivity

Contact Information: LTC Rolf 913-684-4713 "rolf@leav-emh1.army.mil"

STATE OF GEORGIA

Example-Networked Classrooms

- Sample - State of Georgia
  - Purpose—State-wide government & education network links for interactive training and distance learning classroom applications.
  - Infrastructure—State connection to 375 sites via T1 line; another 41 Telemedicine sites within the state, and a Satellite down-link to over 2,200 sites.
- Observations
  - Leverage Statewide terrestrial and satellite infrastructure to provide DL classrooms for Reserve Component and possibly Active Army usage
  - Consortium and Partnership opportunities exist

See Georgia State University entry for related information

Contact Information: Bob Reese "breese@doas.state.ga.us"

INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS

Example-Standards Development

- Sample - Institute for Electrical & Electronic Engineers (IEEE)
  - Purpose—working & study groups to develop standards, guidelines, and recommended practices for computer-based learning.
  - Computer Society Standards Activities Board (SAB); IEEE; Industry & Academic Professionals collaborate in working & study groups.
  - Standards development —Reference Model/Architecture; Learner Model; Dictionary; Task Model; Learning Agreement; Session Management Language; Protocols for Tools/Agents; Task Ontology; and Authoring Tools.
- Observations
  - Courseware modularity requires definition of technical standards for developing content in the basic modules first.
  - Standards will provide enabling tools, courseware, information, and services on a component basis.
  - Through a distributed approach; encouraging the development of many different standards, with networked SMEs, organizations and consortiums, a natural selection of standards will form cornerstone building blocks to eventually deliver workable learning systems based on successful standards.
  - The field of computer-based learning (or Interactive Multimedia Instruction) has a need for a wide variety of technical standards. The IEEE P1484 Working and Study Groups (10 groups to date, and growing) are working to identify and develop such standards. Representatives of the U.S. Army lead the creation of this initiative and remain active. With

the Army's Education and Training Challenge, these efforts of the IEEE and the active role these representatives are taking in the development of the needed standards should be accelerated.

Contact Information: James Schoening 908-532-0118 "schoenin@doim6.monmouth.army.mil"

UNION CITY

Example-Networked Students & Instructors

- Sample - Union City, New Jersey
- Observations: The Union City project has to be considered a major success. It has improved the scores of children in urban inner-city environment. In addition, it has served as a catalyst to focus the cooperation and attention of major players in the educational community. The community as a whole has rallied around this project, and the results of five to six years of effort are amazing! Who has been involved and made major contributions? The state of New Jersey changed the funding profile for public school education. The Union City Board of Education got the teachers' union to give up certain programs in order to fund this new initiative. Teachers re-designed the curricula. Bell Atlantic's foundation provided scholarships to teachers who wanted to utilize new technology. Bell Atlantic's foundation provided scholarships to teachers who wanted to utilize new technology. Bell Atlantic provided access and computers in the homes of 150 students. The entire community exhibited the patience to start this program and to wait until it had advanced enough to start classes. Finally the parents let their children have a new experience. The project started in 1987 that's a decade ago. It took 3 years to get the courses redesigned and the teachers ready to deliver then in this new environment. It took another 3 years to get the technology into place. Since then the bandwidth required to support the enterprise decreased from T1 access to ISDN access. Two years later truancy had almost disappeared, test scores had been raised from 60% failure rates on state wide normal tests to the point where the children score 10% higher than average in all subjects. The last measure of success is buy-in. Today more children apply for admission than there are tenant spaces in Union City! The project continues to evolve. Visit their home page on the world wide web.

Contact information: **http://www.union-city.k12.nj.us**

WORLD LECTURE HALL

Example-Internet DL Courses

- Sample - World Lecture Hall
- Observations: The World Lecture Hall is a compendium of courses that are available over the world wide web. The subject matter ranges from accounting to virology. Classes for over ninety general subjects are cataloged. Each category contains a number of sub-categories. An example of selecting Atmospheric Sciences yields a course on "Our Changing Atmosphere" whose home page Illustrates the following:

OUR CHANGING ATMOSPHERE

Syllabus	WeatherNet
Grading	Weekly Work
Schedule	Lecture Notes
News/Updates	Query

Contact Information: http://www.utexas.edu/world/lecture/

Selected Examples of Current DL Capabilities					
DL Advantages	**Established Program**	**Pilot Program**	**Reference Material**	**Studies**	**Digital Libraries**
Lean	CSU LSMC	CVU Kansas U (KU)	ASTD	IDA RAND	
Convenient	OSU Union City CSU LSMC NTU	CMU CVU KU	ASTD Ft. Knox	IDA RAND	CALL
Faster	OSU Ford Motor Co. U Mass	CMU	ASTD	MITRE IDA RAND	CALL
Better	UNL Union City	CMU KU	IEEE ASTD	MITRE IDA RAND	CALL CAC
Cheaper	CSU LSMC NTU	OSU	IEEE ASTD	IDA RAND	

APPENDIX E

ACADEMIC INSTITUTIONS OFFERING GRADUATE DEGREES VIA DISTANCE LEARNING

Academic Institutions Offering Graduate Degrees via Distance Learning

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
The American College 1983	Master of Science in Financial Services (MSFS) Master of Science in Management (MSM)	Computer Independent Study	Two one week sessions Two one week sessions	amercoll.edu/pagesAevei2/ msfs.htm amercoll.edu/pagesAevel2/ msm.htm
Auburn University	Masters in Hotel/Restaurant Management (HRM) MBA in Finance, Marketing, Operations Management, Management of IS or Management of Technology Master of Science (MAE, MS)/Ph.D. in Aerospace Engineering Master of Science (MS, MCE)/Ph.D. in Chemical Engineering Master of Science (MS, MCE)/Ph.D. in Civil Engineering Master of Science (MS,MCSE)/Ph.D. in Computer Science and Engineering Master of Science (MS, MEE) in Electrical Engineering Master of Science (MS, MIE)/ Ph.D. in Industrial Engineering Master of Science (MS, MAE) Ph.D. in Materials Engineering Master of Science (MS, MME)/ Ph.D. in Mechanical Engineering	Video tape and satellite	45 quarter hours Masters: 1 quarter Ph.D.: one year Masters: 1 quarter Ph.D.: one year Masters: 1 quarter Ph.D.: one year Masters: 1 quarter Ph.D.: one year Masters: 1 quarter Ph.D.: One year Masters: 1 quarter Ph.D.: One year Masters: 1 quarter Ph.D.: One year	auburn.edu/outreach/dl/ eng.auburn.edu/department/eop/bus1.htm eng.auburn.edu/department/eop/aero.htm eng.auburn.edu/department/eop/chem.htm eng.auburn.edu/department/eop/civil.htm eng.auburn.edu/department/eop/compu.htm eng.auburn.edu/department/eop/elect.htm eng.aubum.edu/department/ eop/ind.htm eng.aubum.edu/department/ eop/mat.htm eng.aubum.edu/department/ eop/mech.htm
Boise State University 1989	Master of Science in Instructional & Performance Technology	computer conferencing via personal computer; video tape; audio tape; computer programs; data bases; slow scan video; fax; telephone;	None	www-cot.idbsu.edu/-ipt/distance/ distancb.htm
California Institute of Integral Studies	Master of Arts in Business Ph.D. in Integral Studies	online computer online computer	two one week seminars per year; two five day seminars a year for first two years; one six day seminar the third year	CIIS.edu/sharedfiles/Judy/ onlineprograms.html CIIS.edu/sharedfiles/Judy/onlineprograms.html

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
California Pacific University 1976	MBA Master of Arts in Management and Human Behavior Doctor of Business Administration	Independent Study	none	cpu.edu/index.htm
Cal State Domingus Hills	Master of Arts in Humanities in Art, Music, Literature, Philosophy, or History	Computer via the internet; Professor contact via mail, telephone, fax, computer; audio cassettes	None	Orca.csudh.edu/~hux/info. html
Central Michigan University 1971	Master of Science Administration in Health Services, Human Resources, International, Public, Software Engineering, and General Administration Master of Arts in Education	Learning packages (mail) video/audio cassettes; internet; interactive TV	None	141.209.121.36:80/DEGREES/
Chadron State College	M.B.A. M.S. or M.A. in Education	Two way Audio/Video, satellite	Site based	cse.edu/schools/IDl/CSCIDL.HTML cse.edu/schools/IDl/CSCIDL.HTML
City University 1976	MBA in Financial Management, Healthcare Administration, Individual Financial Planning, Information systems, Managerial Leadership, Marketing Technology/Engineering Management, Telecommunications Management General Master of Arts in Education/ Master of Education	Online; email/ independent study	None	cityu.edu/programinfo/
Clarkson College 1990	Master of Science in Health Service Management Master of Science in Nursing	Computer bulletin Board system, teleconference calls, audio and video tapes		clarksoncollege.edu
College of St. Scholastica	Master of Education Master of Arts in Management		Two weekend seminars Two weeks each summer	css.edu/acad/grad/edu/distant.html ?distance learning homepage from above address
Colorado State University 1967	MBA Master of Science in Management Master of Science in Computer Science PhD in Engineering	Video tape	None None None Two semesters	Cobweb.cobus.colostate.edu:80/html/disted/bow.html See: colostate.edu/Depts/SOE/contZ.html See above See above
Colorado State U at Boulder 1967	M.B.A. Masters of Arts in Public Administration	Cable TV, satellite, video, internet Cable TV, satellite, video, internet	None	colorado.edu/cewww/catalog/details.html#MDDE colorado.edu/cewww/catalog/details.html#MDDE
Embry-Riddle Aeronautical University 1993	Master of Aeronautical Science in Aviation/Aerospace Management or Aviation/Aerospace Operation	Video, personal computer, online forum, audio tape	None	Ec.db.erau.edu/dis/dis_grad.html (http://www.ec.erau.edu/cdl/index.htm http://edtech.db.erau.edu/ are of interest)

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
The Fielding Institute	PhD in Clinical Psychology PhD in Human Development PhD in Human and Organizational Systems Doctor of Education		300 hours one week orientation; 2 one week learning sessions; local monthly cluster meetings	fielding.edu
Empire state College 1984	Master of Arts in Business and Policy Studies, Liberal Studies, or Social Policy	Computer, mail, telephone, audio tape, TV	3-4 days 3 times per year	esc.edu/HTMLpages/academic.htm#grad
Georgia Institute of Technology 1985	Master of Science in Electrical Engineering, Environmental Engineering, Health Physics/Radiological Engineering, Industrial Engineering, and Mechanical Engineering	Video and Computer based delivery; phone, fax, e-mail	None	conted.gatech.edu/distance/coll-gen.html
Goddard College Late 1970	Master of Arts (Individualized) Master of Fine Arts in Writing Master of Arts in Education Expressive Arts in Education School Guidance Psychology and Counseling and Social Ecology	Independent study	One week each semester; Education and Social Ecology also require three weeks per summer	Sun.goddard.edu/gc/adm/home.html
Graceland College	Master of Science in Nursing	Video, internet, independent study	21 out of 43 semester hours	GC-outreach.com/outreach.html
Grand Rapids Baptist Seminary	In-Ministry Master of Religious Education	Audio cassette	12 out of 32 credits through 2 week summer sessions	cornerstone.edu/GRBS
Grand Valley State U.	Master of Business Administration Master of Education Master of Science in Nursing Master of Social Work	Interactive television; satellite transmission; videocassette (one-way and two way transmission) computer	Site based	gvsu.edu/acad/continue/distance.hyml
Indiana State University 1989	Master of Science in Human Resource Development for Higher Education and Industry Coming Fall 1997, Phd in Technology	Satellite with interactive audio World Wide Web	One Saturday session per course	Web.indstate.edu:80/coned/
Iowa State University	Master of Agriculture; Master of School Mathematics; Master of Engineering Systems; Master of Engineering; Master of Family and Consumer Sciences	Iowa's fiber optic system satellite, video tape	One to two weeks	exnet.iastate.edu/pages/ece/programs.html#MESE
John F. Kennedy U. 1981	Master of Arts in Career Development	Correspondence (mail)	Three two week summer sessions	jfku.edu/manage/welcome2.html#CAR
Johnson Bible College mid 1980's	Master of Arts in New Testament	video	Three one week campus visits	2.jbc.edu/johnsonbiblecollege

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
Lesley College	Master of Arts Master of Education	Independent study	Four meetings	lesley.edu
Liberty University 1990	Master of Arts in Divinity Master of Arts in Counseling Master of Arts in Religion	Video cassette	6 hours	liberty.edu/admissions/edp
Loma Linda University 1973	Master of Public Health in Health Promotion or Health Administration	Site based	Three days, once per quarter	llu.edu/LLU/SPH/mph.html#anchor 458077
Loyola University	Master of Religious Education Master of Pastoral Studies	videotapes	None	loyno.edu/3-LNOHomePage.html
The McGregor School of Antioch University	Master of Arts (Individualized) Master of Arts in Conflict Resolution, Environment and Community and Intercultural Relations	Independent Study	Two eight day seminars	
Mind Extension University/George Washington University	Master of Arts in Education and Human Development with a concentration in Educational Technology Leadership	Video, audio, computer, telecommunication	none	gwu.edu/-etl/etlblurb.html
Mississippi State University 1995	Master of Science in Vocational Rehabilitation Counseling	Satellite, compressed video networks, videotapes, audiotapes, internet	Site based	msstate.edu/Dept/CED/dl.html
National Technological University 1985	Master of Science in: Chemical Engineering; Computer Engineering; Computer Science; Electrical Engineering; Engineering Management; Hazardous Waste; Management; Health Physics; Management of Technology; Manufacturing Systems Engineering; Materials Science and Engineering; Software Engineering; Special Majors Program; Transportation Engineering	Satellite, internet	None	ntu.edu
New College of Hofstra University	Master of Arts in Interdisciplinary Studies	Independent Studies (call)	Periodic visits	Vaxc.hofstra.edu:70/1lgopher_root%3A%5B000000.vaxc.schools.nuc%5D
New Jersey Institute of Technology 1982	Master of Science in Information Systems Master of Science in Engineering Management	Video cassette, online conferencing, e-mail, fax, telephone	None	njit.edu/dl
Newport University	MBA; Doctor of Business Administration; Master of Arts in Marriage, Family and Child Counseling; Master of Arts in Psychology; Master of Arts in Religion; Master of Arts in Education; Master of Science in Engineering; Doctor of Education; PhD in Human Behavior; PhD in Psychology; J.D.; MBA/JD	Self study, mail, phone, e-mail	None	newport.edu/welcome.htm

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
Nova Southeastern U. 1971	Masters in Life Span Care Administration Master of Science in Instructional Technology and Distance Ed. EdD in Instructional Technology EdD in Child and Youth Services	Online instruction	MS:One 8-day summer session, Three 3-6 day sessions EdD: Three 8-day summer sessions Four 3-6 day sessions; Two 3-6 day sessions/year Two 8 day summer sessions	nova.edu nova.edu/pet/itde.html nova.edu/pet/cys.html
Oklahoma State University 1990	MBA Master of Science in Computer Science Master of Science in Telecommunications Management Master of Science in Electrical Engineering or Mechanical Engineering	Two way video	6 Saturday Seminars Site based Site based Site based	pio.okstate.edu/extension.html
Portland State University	MBA Master of Arts in Curriculum and Instruction Master of Arts in Special Ed.	Site-based videotape	One Saturday twice a year	Extended.portals.pdx.edu/programs.html
Presbyterian School of Christian Education	Master of Arts in Christian Education	Independent Study	Two weeks per term	
Purdue University	Master of Science in Engineering; Master of Science in Electrical Engineering; Master of Science in Industrial Engineering; Master of Science in Mechanical Engineering	Satellite, videotape	Site based	Fairway.ecn.purdue.edu/cee/Index.html
Regent University 1993	MBA Master of Arts in Management PhD in Communication and Arts Master of Arts in Practical Theology PhD in Organizational Leadership	Internet, video, audio tape, e-mail; internet; study guides, audio tape, internet; internet;	Two 1 week sessions; 4 week summer orientation; 2 credit seminar each summer -- 1 week/year 3 summer sessions	regent.edu/acad/schbus/ regent.edu/acad/schcom/phd/ regent.edu/acad/schdivfb.html regent.edu.acad/cls/olphd/proginfo/c102000.html
Regis University	Master of Arts in Liberal Studies Master of Arts in Community Leadership MBA	Independent study Video, computer, audio tape	Two day orientation one day each semester; 3 week summer courses none	205.214.66.86:443/grad/gradsps.htm mbaregis.com
Rochester Institute of Technology	Master of Science in Information Technology; Master of Science in Software Development and Management; Master of Science in Health Systems Administration	Internet, fax, phones	None	isc.rit.edu/-613www/Dloptions.html#DegreeP
Saint Joseph's College	Master of Health Service Administration	Independent study, telephone, mail	2 two week sessions	
Saint Mary-of- the-Woods College	Master of Arts in Pastoral Theology	Independent study	Two day orientation; one day per semester	Woods.smwc.edu/wed.html
Saint Mary's University of Minnesota	Master of Arts in Human Development; Master of Arts in Education	Independent study	Three to eighteen days	smomn.edu

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
Salve Regina University	Master of Arts in Human Development; Master of Arts in International Relations; Master of Science in Management	Mail, telephone, e-mail	Five days	salve.edu/ges.html
Saybrook Institute	Master of Arts in Psychology; Master of Arts in Human Science; PhD in Psychology; PhD in Human Science	Mail, telephone, computer	2 sessions per year	saybrook.org/
Skidmore College 1993	Master of Arts in Liberal Studies	Independent study	One week	skidmore.edu
Sonoma State University	Master of Arts in Psychology	Independent study	Four units; weekly meetings with advisors	sonoma.edu/psychology/catalog/externalMA.html
Southeastern University	MBA	correspondence	One week	
Syracuse University 1966	Master of Arts in Advertising Design or Illustration Master of Science in Communications Management Master of Business Administration Master of Social Science Master of Library Science Master of Science in Nursing Master of Science in Information Resource Mgmt	Independent study	2 summer weeks/yr 1 week per quarter 1 week per quarter 2 summer weeks/yr 1-4 summer weeks 3 weeks in June 1-4 weeks	syr.eduwww.Syr/AcademicLife/ISDP/
Teachers College/Columbia University 1981	Master of Arts in Adult and Continuing Education Ed.D in Adult and Continuing Education	e-mail, fax, phone, mail	3 weeks during 3 summers; four weekends	tc.columbia.edu/
Thomas Edison State College 1971	Master of Science in Management	Computer based	One week orientation, one week at end of each two years	tesc.edu/programs.htm#Mas
The Union Institute 1964	PhD in anything in Arts and Sciences	Independent study	Three five day seminars	tui.edu
University of Alabama	Master of Science in Aerospace Engineering; Electrical Engineering; Mechanical Engineering; Civil Engineering; Environmental Engineering; or Engineering	Videotape, e-mail, phone	Site based	Ualvm.ua.edu/-cstudies/ccs.html
University of Arizona-Tucson	Master of Arts in Library Science PhD in Library Science	Videotape, internet	Three to ten week summer sessions	W3arizona.edu/-uaextend/
University of Colorado-Boulder	M.E. or M.S. in Aerospace Engineering; Civil and Environmental Engineering; Computer Science; Electrical and Computer Engineering; Engineering Management; Mechanical Engineering or Telecommunications	Live TV broadcast with two audio	none	colorado.edu/Cont.Ed/addition/catecs.htm
University of Dallas	MBA Masters of Management in Health Services Management	TV Broadcast, some interactive	none	Gsm.udallas.edu/
University of Houston	Master of Electrical Engineering; Master of Science in Occupational Therapy; Master of Industrial Engineering; Master of Hospitality Management Therapy; Master of Science in Computer Science	Live, interactive, instructional tv, videotape, online	Site based	uh.edu/academics/de/buttons.html

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
University of Idaho	Masters of Science or Master of Engineering in: Agricultural Engineering; Civil Engineering; Computer Engineering; Electrical Engineering; Geological Engineering; Master of Science in Human Factors; Psychology; Computer Science; Master of Engineering in Mechanical Engineering; PhD in Computer Science	video	Two to three days at the end of program for all masters Two semesters	uidaho.edu/academics/outreach.html
University of Illinois at Urbana Champaign	Masters of Science in Electrical and Computer Engineering; General Engineering; Mechanical Engineering; Theoretical and Applied Mechanics	videotape	Site based	uiuc.edu/resources.html
University of Mass. At Amhurst 1974	Masters of Science in Electrical and Computer Engineering or Engineering Management	Videotape, satellite/two way audio	None	Zonker.ecs.umass.edu/vip/index.html
University of Minnesota	Masters in Health Care Administration Masters in Public Health in Health Services Administration		Two weeks at beginning of each year; four weeks at end of third year	
University of Montana	MBA	Live interactive broadcast television	Two days per week	umt.edu/ccesp or umt.edu/nss/gradcat/business.htm
University of Nebraska-Lincoln 1909	Master of Science in: Computer Science; Industrial and Management Systems Engineering; Manufacturing Systems Engineering; Mechanical Engineering; Human Resources and Family Sciences; Master of arts in Journalism; M.B.A.; Ed.D in Administration, Curriculum and Instruction	Live, interactive broadcast television	Once or twice a week Two summers on campus for Ed.D	unl.edu:80/conle/disted/DistEd.html
University of New England	Master of Science in Education	Video, telephone, e-mail, fax	One week each summer	une.edu/
University of North Carolina at Chapel Hill 1970	Master of Public Health in Management or Dental Public Health Master of Healthcare Administration	Independent study	Six weeks per summer, 2 weeks per winter	sph.unc.edu/hpsa
University of North Dakota	Master of Science in Space Studies MBA Master of Public Administration	Videotape, conference calls, internet ; Interactive video Interactive video	Two weeks each summer	und.edu/dept/conted/learn.htm
University of Oklahoma 1961	Master of Liberal Studies	Independent study Satellite, compressed video	Three seminars	uoknor.edu/cis/
University of Phoenix 1990	MBA; MBA/Global Management; MBA/Technology Management; Master of Arts in Organizational Management; Master of Arts in Education; Master of Nursing	Independent study Phone, fax, voice mail	None	uphx.edu/center/

Institution & DL Init.	Degrees Offered	Delivery Medium	Residency	Web Site – www.
University of Phoenix, Online Campus 1989	Master of Arts in Organizational Management MBA MBA in Technology Management	Online	None	uphx.edu/online/
University of South Carolina 1970	MBA	Interactive digital satellite transmission	Once a week, plus 15 Saturdays/year	business.sc.edu
University of Tennessee Space Institute	Master of Science in Industrial Engineering Management	Interactive video or videotape	Site based or none	utsi.edu/
University of Virginia 1983	Master of Engineering in Civil, Chemical, electrical, Mechanical, and Aerospace Nuclear or Systems Engineering; Master of Materials Science and Engineering	Interactive video	Site based twice per week	Watt.seas.virginia.edu/-rfk2u/index.html
University of Wyoming	Master of Arts in Education in Adult and Post Secondary Ed; Master of Science in Speech Pathology MBA; MPA	Interactive compressed video and audio teleconferencing	Site based	Luci.uwyo.edu
Vermont College of Norwich University 1960	Master of Arts Master of Fine Arts in writing Master of Fine Arts in visual Art	Independent study, phone, fax, e-mail	Quarterly seminar; Twelve days every six months; Ten days every six months;	norwich.edu/grad/
Virginia Commonwealth University	Master of Science in Health Administration	World wide web	One week at beginning and end of each semester	vcu.edu/haeweb/hae.html
Walden University	Master of Science in Educational Change and Technology Innovation; Doctor of Education; PhD in Administration/Management Education, Health Services or Human services	Self directed research	One four day intensive session per year; and one three week summer session or two, two week summer sessions	

Universities With Non-Graduate Distance Learning Programs:

Adams State College
America Academy of Nutrition
American College of Prehospital Medicine
American Open U.
Arizona State University
Athabasca University
Atlantic Union College
Bemidji State University
Board of Governors Universities
Boston University
Boyce Bible School
Brigham Young University
Burlington College
Caldwell College
Carnegie Mellon U.
Charter Oaks State College
Chemeketa Community College
Clemson University
Cleveland Institute of Electronics
Columbia Union College
Colombia University
Dalhousie University
The Defiance College
Diversity University
Duke University
East Tennessee State University
Eastern Kentucky U.
Eastern Oregon State College
Eckard College
Elizabethtown College
Grantham College of Engineering
Griggs University
Global Electronic Multimedia University
Global Laboratory
Global School Net
ICS Center for Degree Studies
Illinois State University
Indiana Institute of Technology
Indiana University
Institute for Global Learning
Johnson State College
Judson College
Kansas Newman College
Kansas State University
Kent State University
Lee College
Mary Baldwin College
Marywood College
Mid-America Bible College
MIT
Moody Bible Institute
Mott Community College
Murray State University
National Institute for Paralegal Arts and Sciences
New York Institute of Technology/Online Campus
North Central Bible College
Northwood University
Ohio University
Oklahoma City University
Open Learning Agency
Open Learning Fire Service Program
Oral Roberts University
Oregon State University
The Paralegal Institute, Inc.
Pennsylvania State University
People's College
Pikes Peak Community College
Prescott College
Regents College, The University of The State of New York
Roger Williams University
Southeastern College of the Assemblies of God
Southern Illinois University
Southwest Texas State University
Southwestern Adventist College
Southwestern Assemblies of God University
State College and University Systems of West Virginia
State University System of Florida External Degree Program
Stephens College School of Continuing Education
Trinity College-Connecticut
Troy State University Montgomery
University of California at Berkeley
University of Connecticut
University of Georgia
University of Hawaii
University of Iowa
University of Kansas
University of Michigan
University of Mississippi
University of Missouri
University of Maryland University College
University of Nevada
University of Pittsburgh
University of Southern Colorado
University of Wisconsin-Platteville, River Falls, Superior
Upper Iowa University
Vincennes University
Virtual On-line University
Washington State University
Weber State University
World College

Other Possibilities:
University of North Texas
University of Northern Iowa

University of Southern Mississippi
University of South Dakota
University of Texas at Austin
University of the State of New York /
Regents College
University of Utah
University of Washington
University of Waterloo
Usenet University - Global Network Academy
Utah State University
Vanderbilt University
Vassar College
Western Michigan University
Yale University

APPENDIX F

THEORETICAL BASIS OF LEARNING

(BEHAVIORISM, COGNITIVE PSYCHOLOGY & CONSTRUCTIVISM)

The Theoretical Basis of Learning

- **Behaviorism** (1950s-1960s)
  - Central Metaphor: People are animals
  - Source of Knowledge: codified sources
  - Instructor Role: Dispenser of external rewards and punishments
  - Goals: Knowledge & Procedures
  - Instructional Features: Immediate feedback, no errors in learning via small increments/steps using drill and practice
  - Assessment: multiple choice testing

- **Cognitive Psychology** (1960s-Present)
  - Central Metaphor: People are computers (e.g., memory is long term (hard drive) and short term (RAM)
  - Source of Knowledge: experts & codified knowledge
  - Instructor Role: Dispenser of information. Training is facilitating the integration of new information with student's existing knowledge
  - Goals: Knowledge, Procedures, and Problem Solving
  - Instructional Features: Delayed feedback, errors used as learning opportunity (synchronous/asynchronous) with lecture/discussion
  - Assessment: Performance Assessment (e.g., simulation)

- **Constructivism** (1980s-Present)
  - Central Metaphor: People are knowledge constructors in social contexts
  - Source of Knowledge: codified distributed knowledge & search
  - Instructor Role: A guide for exploring individual and collective tasks
  - Goals: Problem Solving, Deep Understanding, and Self-Regulation
  - Instructional Features: Discussion, guided discovery, collaborative learning, extensive use of context
  - Assessment: Performance Assessment and Qualitative (ethnographic) approach

APPENDIX G

COMPARISON TABLE SHOWING COURSEWARE CONVERSION COSTS UNDER EXISTING ADLP AND TWO ACCELERATED COURSE CONVERSION SCHEDULES

TATS-C Conversion Table

This chart is based on data in the existing Army Distance Learning Plan. The three columns under Existing ADLP provide numbers on courseware conversion found in the ADLP Technical Volume. The columns under 30% Conversion and 50% Conversion are based on accelerated courseware development schedules and represent courseware costs with increased initial conversion funding and immediate reinvestment of Per-Diem savings back into the conversion process. This illustrates how accelerated courseware development can result in a rapid return on investment.

FY	Existing ADLP			30% Conversion		50% Conversion	
	Cost for Conversion to CW	Courses Converted	Cost/ Course	PD Cost Avoided	Courses Converted	PD Cost Avoided	Courses Converted
98	19,737	31	636.7	114,126.1	179	190,210.2	299
99	21,396	31	690.2	114,126.1	165	190,210.2	275
00	13,223	31	426.5	114,126.1	267		**574**
01	17,745	31	572.4		**611**		
02	20,036	31	646.3				
03	25,840	47	549.8				
04	28,764	47	612.0				
05	24,369	47	518.5				
06	26,664	47	567.3				
07	20,812	47	442.8				
08	35,760	47	760.8				
09	9,995	47	212.6				
10	4,609	41	112.4				
Total	**268,950**	**525**	512.3				

APPENDIX H

CARNEGIE MELLON UNIVERSITY PRESENTATION ON THE EFFECTIVENESS OF INTELLIGENT COMPUTER AIDED INSTRUCTION

Appendix H
Effectiveness of Intelligent Computer-aided Instruction

Dr. Ken Koedinger
Human-Computer Interaction Institute
Carnegie Mellon University

Codirector of Pittsburgh Advanced Cognitive Tutor (PACT) Center
with John R. Anderson & Albert Corbett

Email: Koedinger@cmu.edu Phone: 412-268-7667

Measuring Instructional Effectiveness

- Gold standard: Individual human tutor or coach is "2 standard deviations" better than classroom instruction (Bloom, 1984).
  - Average tutored student is better than 98% of students receiving classroom instruction.
- Effectiveness of educational technologies
  - Computer-aided instruction = 0.5 sd (meta-analysis of 100s of studies)
  - Simulations, multimedia = 0? (few studies, some negative)
  - Cognitive tutors = 1 sd

ACT: A Cognitive Theory of Learning and Performance

- Features of complex skill acquisition:
  - Learning by doing, not by listening or watching
  - Knowledge is composed of "production rules"

Productions are:		Instruction implications:
• modular	⇨	isolate skills & optimize
• context specific	⇨	address "when" as well as "how"

Anderson, J.R. (1993). Rules of the Mind. Lawrence Erlbaum.

Cognitive Tutors: A Technology to Support Learning By Doing

- Cognitive Model: Incorporates different strategies and typical student misconceptions

  Rule: IF the goal is to solve a(bx+c) = d
  THEN rewrite this as bx + c = d/a

  Rule: IF the goal is to solve a(bx+c) = d
  THEN rewrite this as abx + ac = d

  Bug rule: IF the goal is to solve a(bx+c) = d
  THEN rewrite this as abx + c = d

- Model Tracing: Follows student through their individual approach a problem -> context-sensitive instruction
- Knowledge Tracing: Assesses student's knowledge growth -> individualized activity selection and pacing

Cognitive Tutor Research: Demonstrations of Effectiveness

- LISP Tutor Success
  - Cognitive tutor for writing computer programs in LISP language
  - Effectiveness: Experimental group completed curriculum in *1/3 the time* with better post-test performance than control

- Geometry Tutor: Field Success
  - Cognitive tutor for geometry proof design
  - Effectiveness:
    - In 2 classroom studies, experimental group *1 sd better* than control.
    - 3rd party evaluator reported gains in motivation & social processes.

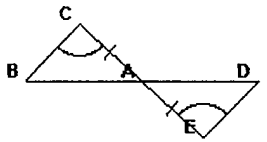
Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences*, 4 (2) 167-207

File Edit Problem Info Review

Hint

Repeat hint

truth #11



GOAL:

A midpoint $\overline{BD}$

$\overline{AD} \cong \overline{BA}$

$\triangle ABC \cong \triangle ADE$

You can prove certain things from the diagram. What might help you prove $\triangle ABC \cong \triangle ADE$?

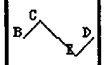
Justify | Define | Unjustify

$\overline{AC} \cong \overline{EA}$

GIVENS:

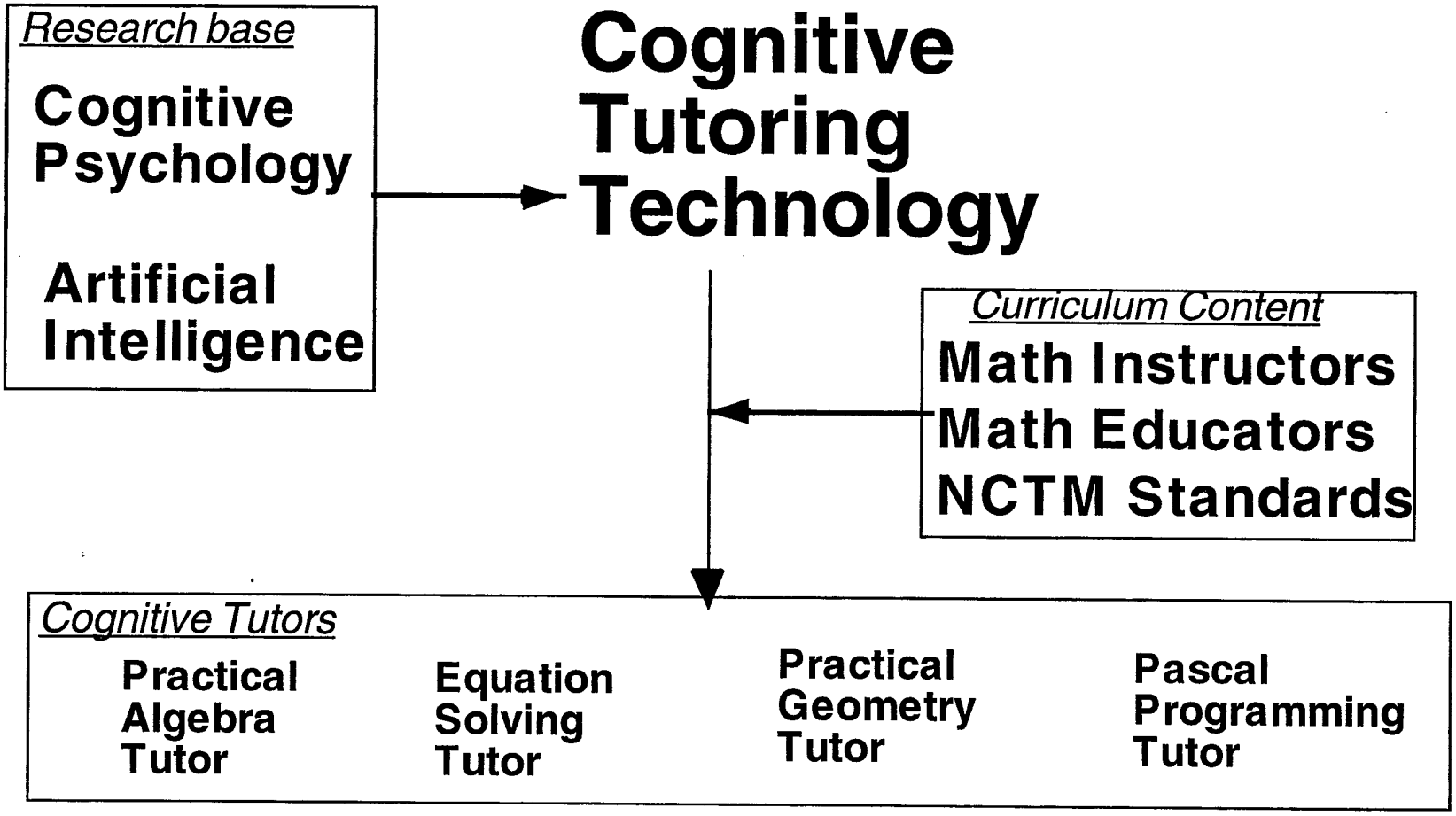
A midpoint $\overline{EC}$

$\angle AED \cong \angle ECB$

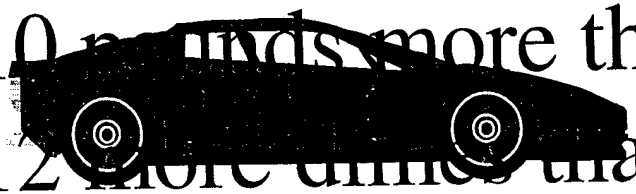


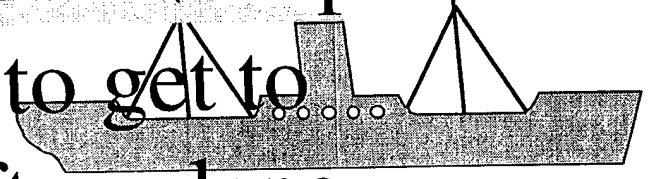
$\overline{BC} \parallel \overline{ED}$

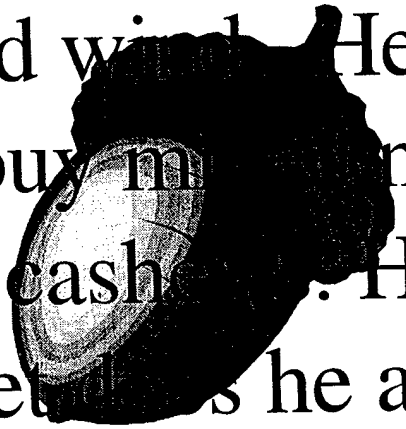
Client-centered Engineering

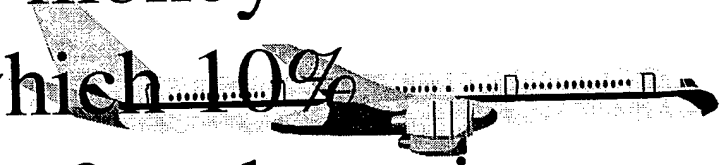


A man twice as old as his sister weighs 10 pounds more than his cousin and has 12 more dimes than quarters in his pocket. He rows 5 miles upstream to get to a candy store. When he left, a plane left for New York flying against a head wind. He uses the money to buy mixed nuts, of which 10% are cashews. How soon after the trains meet does he arrive at the store? What are the dimensions of the store?









Cellular Phone Assessment

You are told that tomorrow you are to order cellular phone service for all the officers in your company. Your boss tells you that she will be providing you with the necessary information about the amount of "airtime" (number of minutes of phone time) per month that each officer will need. She also informs you that she will have this information for you about an hour before you must present your report and decision to the President of the company. Furthermore, she makes it very clear that your future with the company will depend on how well you perform this duty.

Knowing that you will need at least an hour to just put your report together, you contact the local cellular phone company. They give you the following information about their three available services.

- *Economy Service*: Each person is charged $19.95 per month and $0.31 per minute of airtime.
- *Silver Service*: Each person is charged $40.95 per month and $0.16 per minute of airtime.
- *Gold Service*: Each person is charged $80.95 per month with no charge for airtime.

To prepare for tomorrow you must do a mathematical analysis of these three different plans. This analysis should include defining variables, writing equations, making tables, constructing graphs, finding slopes and intercepts, and finding points of intersection. Your boss suggests that you look at these plans over a range of airtime from 0 to 500 minutes per month, and how much airtime that you can get per month with each of these plans for a total cost of $100. She also makes it very clear that you must **include the range of airtime for which each plan is the cheapest**.

"PAT": Practical Algebra Tutor

Edit Windows Students Problem Solver 7:31:45

Problem Statement

GENERAL DIRECTIONS

Our goal is to complete the worksheet and to construct a graph showing two different algebraic equations on the same set of axes. If you need more information about completing the worksheet, or constructing the graph, directions are available under the PROBLEM menu.

PROBLEM

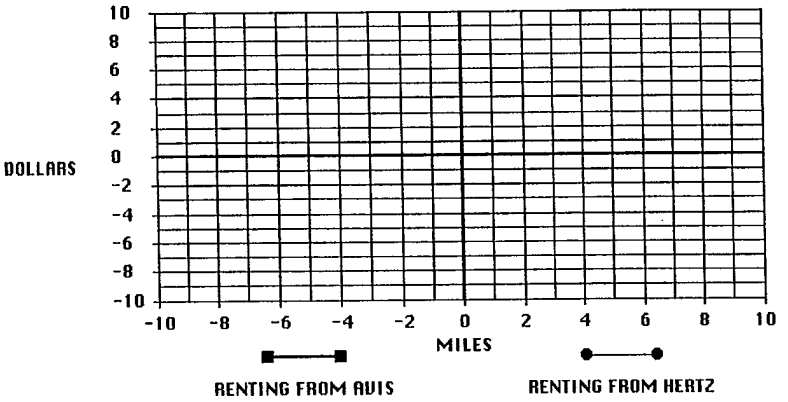
We need to rent a large truck for one week. Rental companies charge an initial cost plus an additional cost for each mile driven. One company, Hertz, will rent a 27 foot truck to us for $525 plus $0.21 per mile. Another company, Avis, will rent us the same size truck for $585 plus $0.13 per mile.

1. What is the initial cost, in dollars, of renting this model truck from Hertz? From Avis?
2. How much would it cost to rent the truck from Hertz if we will be driving it 500 miles? From Avis?
3. If we have budgeted a total of $850 to rent this truck, how many miles can we drive it if we rent it from Hertz?
4. If we have budgeted a total of $1000 to rent this truck, how many miles can we drive it if we rent it from Avis?
5. How many miles would we need to drive the truck so that the cost of rental from each company would be equal?

For the formula, define a variable for the number of miles driven and use this variable to write rules for the cost of renting the truck from Hertz and the cost of renting the truck from Avis.

Grapher

	Lower Bound	Upper Bound	Scale Size
MILES Settings	-10	10	1
DOLLARS Settings	-10	10	1



Worksheet

	MILES DRIVEN	COST OF RENTING FROM HERTZ	COST OF RENTING FROM AVIS
UNIT	MILES	DOLLARS	DOLLARS
FORMULA	X	0.21X+525	0.13X+585
1	0	525.	585.
2	500	630.	650.
3	1547.619	850	786.1905...
4			
5			

Messages

You can calculate the distance driven by manipulating the expression the cost of renting from avis equals 0.13 times the distance driven plus 585.0.

Equation Solver

850 = 0.21X+525

Subtract 525

325 = 0.21X

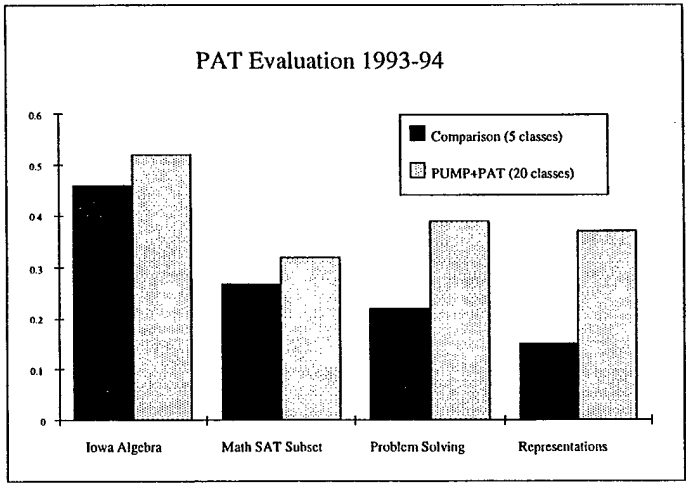
Divide by 0.21

1547.619 = X

Lesson Ten (SYS02)

- ✓ Labelling worksheet columns
- ✓ Identifying units
- ✓ Entering a given
- Find Y, negative slope
- ✓ Find Y, positive slope
- Find Y, Simple
- Find X, negative slope
- Find X, positive slope
- Find X, simple
- Defining a variable
- Write expression, negative s
- Write expression, positive s
- Write expression, simple
- Making a graph
- Labelling axes on the graph
- Labelling lines

Evaluations of PAT



- Controlled comparsons in 4 city schools replicated over 2 years:
  - 15% better than control classes on standardized tests.
  - 100% better on problem solving & representation use.

Koedinger, K.R., Anderson, J.R., Hadley, W.H., & Mark, M. A. (1995). Intelligent tutoring goes to school in the big city. In *Proceedings of the World Conference on Artificial Intelligence in Education*, AACE: Charlottesville, VA. (Best paper award.)

- Controlled comparisons in remedial math course at 2 colleges:
  - 50% better than controls on problem solving

Koedinger, K. R., & Sueker, E. L. F. (1996). PAT goes to college: Evaluating a cognitive tutor for developmental mathematics. In *Proceedings of the Second International Conference on the Learning Sciences*, (pp. 180-187). AACE: Charlottesville, VA.

Conclusions

- Effectiveness: ITS (1 sd) better than CAI (.5 sd), but not as good as human tutors (2 sd)
- Cognitive tutors:
  - Driven by cognitive theory & empirical testing
  - Effective for:
    - symbolic skill domains (LISP & Geometry tutors)
    - complex applied problem solving (PAT)
- Interaction, not interface is what matters
  - Flashy interface not necessary for effectiveness

Future Plans

- Continued dissemination & testing of PAT
  - 30+ schools in US and DoD schools in Europe
- Further cognitive research & development
  - Cognitive Tutors for Geometry & Algebra 2
  - Demonstrate dramatic learning gains on SAT...
- Plug-in "Tutor Agents"
  - Live inside software performance tools, like spreadsheets, or simulations, like science labs
  - Available on internet

Ritter, S. & Koedinger, K. R. (1997). An architecture for plug-in tutoring agents. In *Journal of Artificial Intelligence in Education*, 7 (3/4), 315-347. AACE: Charlottesville, VA.

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